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Psychosocial Variables in the Adoption of Assistive Technology Among Deaf and Hard of Hearing Adults

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Psychosocial Variables in the Adoption of Assistive Technology Among Deaf and Hard of Hearing Adults

by

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DISSERTATION

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Psychosocial Variables in the Adoption of Assistive Technology Among Deaf and Hard of Hearing Adults

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Despite the incredible gains in communication technologies, barriers to communication remain. Certain groups in particular tend to experience marked communication difficulties, including people who are Deaf and Hard of Hearing. Assistive technology can help an individual with a disability eliminate a range of communication barriers and increase participation in activities of daily life, in work, and social settings, but many devices are abandoned in their first year of use. Psychosocial factors may have significant impact on how a person evaluates his or her decision to use assistive technology, in keeping with Rogers' Theory of Diffusion of Innovations, which serves the theoretical framework for

this study. The study's null hypothesis states that Psychosocial and demographic variables will not predict among four levels of adoption of video relay services (VRS). Stated more technically, linear combinations of psychosocial and demographic variables will not discriminate among four levels of adoption of VRS assistive technology. The population for this study included only adult employees of the Texas School for the Deaf, with a total 103 respondents. Two data collection instruments were used- a demographic questionnaire and the Psychosocial Impact of Assistive Device Scale (PIADS). The demographic questionnaire gathered information related to characteristics of early and late adopters of innovations as per Roger's Theory. The PIADS is a 26 item self-report of psychosocial factors of independence, well being and quality of life. This study employed a non-experimental research design. Multiple Discriminant Analysis (MDA) was chosen as the statistical technique most appropriate for testing the hypothesis. Results indicate that the psychosocial variables of Competence, Adaptability and Self-Esteem were predictive of group membership in the adopter category. Communication Mode, Title, Past Phone Use, Years of Employment, Hearing Level, and Training variables also had predictive utility for group membership. Of demographic variables, only Training was highly

correlated to Competence and Adaptability. Possible study limitations include novelty effect, and pro innovation bias and associated with the introduction of an innovation.

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CHAPTER I INTRODUCTION

From prehistoric methods of smoke signals and drum beats, through the development of cuneiform, hieroglyphics, and the alphabet, and into more modern innovations such as moveable type, telegraphs, and the telephone, communication technologies span human history. Of the many varied communication innovations that have occurred over time, a consistent trend is revealed- communication has steadily moved away from symbolic and representational forms and become increasingly text-based (Jawitz, 1996). Today, as spoken languages are actually disappearing, new text-based languages intended for use with modern communication devices and tools, such as computers, are rapidly developing (Jawitz, 1996; Kittler, 1996).

The more people need to communicate, the greater number of tools and devices are developed to facilitate faster, more accurate, and broader reaching technologies. But technology alone is insufficient to improve communication. Technology may be utilized to organize data into information, but information becomes communication only as a person mediates it. (Gillard & Johansen, 2004; Jawitz, 1996; Kittler, 1996).

Despite the incredible gains in communication technologies, barriers to communication remain. Indeed, some advances in communication technologies that have

greatly benefited the majority public actually inhibit communication for others. Certain groups in particular tend to experience marked communication difficulties, including people who are Deaf and Hard of Hearing. The number of people in the United States with hearing loss is rising. According to the 1994 National Health Survey (Better Hearing Institute, 1999), there were approximately 22 million people with hearing difficulties ranging from a mild loss to total Deafness. In 2001, that figure rose to a little more than 28.4 million. Of the people identified, about 7.0 million were reported as having 'a lot of trouble hearing or Deaf', which represents approximately 3.4% of the United States population (Better Hearing Institute, 1999; Lucas, Schiller & Benson, 2004).

Some of the major issues people who are Deaf and Hard of Hearing tend to experience are communication barriers with and isolation by the larger society. Some of the effects of communication barriers between persons who are Deaf or Hard of Hearing and the general population are as follows: (1) social and familial isolation, often leading to depression and behavior problems (Allen, 1994; Better Hearing Institute, 1999; Hindley, 2000; Gallaudet Research Institute, 2003), (2) deficits in academic skills and school-related social and behavioral skills (Gallaudet Research Institute, 2003; Holt, Traxler, & Allen, 1997),

(3) fewer options in state and federal vocational rehabilitation programs (Capella, 2003), and (4) unemployment and underemployment with resultant dissatisfaction with socioeconomic status (Allen, 1994; Lucas, Schiller & Benson, 2004).

Isolation

Feelings of isolation due to communication barriers within the family and society can be prevalent among people who are Deaf or Hard of Hearing. The Deaf often have negative experiences with the Hearing world. These experiences have been described alternatively as alienation (Schein, 1989), oppression (Lane, Hoffmeister, & Bahan, 1996), or paternalism (Lane, 1992). Smart (2001) even suggests that Deaf and Hard of Hearing people have been subjected to more paternalism than any other disability group, primarily because educators and medical professionals have strong opinions regarding the best possible communication strategies for the Deaf. Regardless of the specific label given, the descriptors all suggest that Deaf and Hard of Hearing people can feel that they are misunderstood by the Hearing world and that the manner in which they are treated is harmful. Perhaps it is understandable then that Deaf people often associate only on a very limited basis with Hearing people (Lane, 1992; Schein, 1989; Smart, 2001). Linguistic isolation is yet

another way in which people who are Deaf and Hard of Hearing become separated from larger society. This type of isolation can begin at a very early age, and both children and adults with hearing loss are negatively impacted.

By some estimates, about 90% of parents of Deaf or Hard of Hearing children are Hearing, but many do not adequately master ASL or other modes of manual communication, due to spoken language being their primary language (Gallaudet Research Institute, 2003). Thus, the majority of Deaf and Hard of Hearing children communicate at home in a language different from what they learn and use in their schools, resulting in an inability to truly talk with their parents. Feelings of isolation can be further amplified by the lack of siblings who are Deaf or Hard of Hearing; an estimated 79% of Deaf or Hard of Hearing children do not have siblings who are Deaf or Hard of Hearing (Gallaudet Research Institute, 2003). Some families take an oral approach and never learn to sign in attempts to help fit the child who is Deaf into the Hearing world, sometimes with the unfortunate outcome of not fitting in any community at all. Considering the difficulties in both expressive and receptive communication within their families, it is not surprising that nearly a third of Deaf and Hard of Hearing children have been

reported to have difficulties with social interactions and behaviors (Gallaudet Research Institute, 2003).

Adults also face significant social alienation due to communication difficulties. Hindley, Kitson, and Leach (2000) report that communication barriers are in part responsible for an increase in adult "life induced" emotional and behavioral problems. In fact, nearly half of Deaf or Hard of Hearing people have experienced some mental health condition that can be attributed to their difficulties in communication, a number that far exceeds that of the general Hearing population (Gallaudet Research Institute, 2003; Hindley, Kitson and Leach, 2000). Unfortunately, the problems may only worsen over time. As Deaf/Hard of Hearing people age, many report that their satisfaction with their lives decreases while social isolation and symptoms of depression increase (Allen, 1994).

Education

The impact of communication barriers on education for people who are Deaf and Hard of Hearing begins very early and has far-reaching consequences. Communication barriers can create a number of negative educational outcomes for Deaf and Hard of Hearing people, including a lack of recognition of and response to environmental stimuli, along with marked difficulties in reading, writing, and

comprehending English (Gallaudet Research Institute, 2003; Holt, Traxler and Allen, 1997).

Recently, the Gallaudet Research Institute (2003) conducted a regional and national survey of 40,282 Deaf and Hard of Hearing children ranging from three years to 18 years old. Of those students, approximately 70% spend all or part of their school day in a resource room or self-contained class despite not needing special education services for cognitive deficits. Because of such placements in schools, Deaf and Hard of Hearing people lack opportunities to fully participate in the school and community environment and miss many rich opportunities for social learning. Also, it is estimated that near 10% of severely and profoundly Deaf students attend oral schools and fail to learn to communicate or comprehend in any mode-oral or manual. An unknown number of orally educated students abandon oral methods later in life (Allen, 1994; Ladd, 2003).

Holt, Traxler and Allen (1997) have found that prelingually Deaf people in general have very low reading levels, noting that of 17-21 year old students, only 25% recorded reading levels of fifth grade or above while only 40% recorded reading levels of fourth grade or above, results which may be in part explain why people who have not graduated from high school are more likely to have

Hearing loss than those who do not have any type of Hearing loss. This limits further educational opportunities and the advancement potential for people who are Deaf (Rawlings, Schildroth & Allen, 1989; Silvesti, & Lukasiewicz, 1989; Allen, 1994; Holt, Traxler & Allen, 1997).

Vocational Rehabilitation Service Provision

Despite the large numbers of Deaf and Hard of Hearing individuals in the country, there has been a decline in the number of people who are Deaf/Hard of Hearing and receiving services from the State and Federal Vocational Rehabilitation Programs (VR) (Capella, 2003). The majority of people who receive services are already employed and may simply receive Hearing aids and/or interpreter services. Communication barriers between the Vocational Rehabilitation Counselors (VRC) and the Deaf and Hard of Hearing population are a primary source of difficulty in seeking and receiving services. Additionally, rehabilitation service providers are often inexperienced, unaware of the variety of services people in this group need, and demonstrate a pervasive lack of understanding of both medical and cultural Deafness/Hearing loss (Capella, 2003).

Deficits in communication, experience, knowledge, and understanding often result in less than optimal outcomes of both the rehabilitation counselor and Deaf/Hard of Hearing

clients. More Deaf and Hard of Hearing clients are ultimately placed in non-compensated jobs, such as "homemaker", than any other disability group. Also, people who are Deaf and Hard of Hearing received more basic restoration and interpreting services and less college and university, training, business and vocational training and adjustment training than people in other disability groups (Capella, 2003). Assuming the primary goal of VR would be to obtain competitive gainful full time employment, more services to a greater number of Deaf and Hard of Hearing clients of the VR program would be an appropriate means of reaching employment goals.

Employment

Hearing loss, combined with previously discussed concerns of social and linguistic isolation, emotional and behavioral problems, educational deficits and low reading abilities, and lack of appropriate and meaningful vocational services all effect the amount of annual income a person generates (Allen, 1994; Lucas, Schiller & Benson, 2004). Many Deaf or Hard of Hearing people are chronically unemployed and/or underemployed (Allen, 1994). Many Deaf people receive Social Security disability payments through Supplementary Security Income (SSI) as their only means of support (Deaf and Hard of Hearing Access Program, 2004). Jobs that require higher levels of reading, frequent

interactions with coworkers, clients, and use of the telephone have not traditionally been open for people who are Deaf or Hard of Hearing.

Issues for the Deaf and Hard of Hearing

People who are Deaf or Hard of Hearing and in the workforce tend to have trade jobs related to transportation, farming, and machine operation and are less likely to be in more lucrative professional areas such as administration or sales. People with an annual family income of $20,000 are twice as likely to have Hearing loss of some level than those who have an annual family income of $50,000. The cumulative effect of chronic unemployment and underemployment can be especially harsh at the end of one's working years: the median net worth of people with Hearing losses as they enter retirement is approximately $65,500, which is considerably less than $102,000 reported for people without Hearing loss (Allen, 1994; Brodwin, Parker, & DeLaGarza, 1996; Better Hearing Institute, 1999; Lucas, Schiller & Benson, 2004).

Clearly, communication barriers with and isolation by the larger society result in negative social, educational, and employment outcomes for the Deaf and Hard of Hearing. For the general society, the communication barriers between Deaf and Hard of Hearing persons and Hearing people cost the U.S. economy an estimated $56 billion annually in lost

productivity and costs of special services (Better Hearing Institute, 1999). Considering the severe negative consequence of communication barriers between people who are Deaf and Hard of Hearing, and the Hearing world, accommodations—in the form of assistive technology—to improve communication between people who are Deaf and those who hear warrant attention (Brodwin, Parker, & DeLaGarza, 1996).

Assistive Technology and Disability

Assistive technology, or AT, is a broad reaching term with any number of definitions given to describe is purpose and scope, however, some agreement among labeling sources can be found (Bryant & Bryant, 2003). The Technology-Related Assistance for Individuals with Disabilities Act of 1988 (P.L. 100-407, now reauthorized under H.R. 4278) was the first legislative definition of assistive technology as "any item, piece of equipment, or product system, whether acquired commercially, off-the-shelf, modified, customized, that is used to increase, maintain or improve the functional capabilities of individuals with disabilities". Taking a slightly broader approach, Bryant and Bryant (2003), have defined AT as "the applications of science, engineering, and other disciplines that results in processes, methods, or inventions that support people with disabilities" (Bryant & Bryant, 2003, p. 2).

At their core, both definitions are grounded in the idea that assistive technology is designed to help an individual with a disability eliminate a range of functional barriers and increase participation in activities of daily life, in work, and in social settings through it's use. There has been an increase in recent years in the number of AT products available to people with disabilities, many of which are highly specialized devices aimed at particular disability groups (Bryant & Bryant, 2003). A wide variety of AT is available for Deaf and Hard of Hearing individuals. Most obviously, there are many models of hearing aids and amplification devices for people who have residual Hearing. Vibrating alarm clocks, pager-connected doorbells, and fire and smoke alarms equipped with flashing lights all impact basic daily activities for people with Hearing loss. But items designed for physical comfort, basic household activities, or environmental safety do little to ameliorate the communication difficulties that lie at the heart of the barrier between the Hearing world and Deaf or Hard of Hearing people. Aimed at remedying the significant consequences of communication barriers, communication technologies have been developed especially for people who are Deaf or Hard of Hearing.

Communication Technology for the Deaf and Hard of Hearing

Communication-related AT for people who are Deaf and Hard of Hearing has an established history. Dating back to 1874 and the invention of the telephone, the issue of Deaf and Hard of Hearing people being unable to fully utilize the telephone system has received some attention. Early communication technology for the Deaf and Hard of Hearing consisted mainly of basic amplification horns attached to part of the telephone (Bat-Chava, Deignan & Martin, 2002). Such basic technology was rarely effective, and as societal dependence upon the telephone increased, the advancement potential of people who were Deaf or Hard of Hearing became more limited. Some even lost their positions and were forced to make career changes (Rawlings, Schildroth & Allen, 1989; Silvesti, & Lukasiewicz, 1989, Allen, 1994).

In attempts to increase and facilitate communication between the Deaf and Hearing populations, Robert Weitbrecht invented the teletypewriter (TTY) also called the telecommunications device for the Deaf (TDD) in the early 1960's, allowing people to type and receive messages over phone lines. However, the early TTY/TDD systems were cumbersome, relatively expensive, mechanically unreliable, and not readily available in the Hearing community (Nelson, 1996; Grossman, 2001; Porter, 1999). It was not until the American with Disabilities Act of 1990 (P.L. 101-336)

mandated the use of relay services that people using TTY/TDD systems were able to communicate with people using regular phones.

Text-based Relay System

The Relay TTY/TDD system operates as a link between two parties, a Deaf/Hard of Hearing person (or person with a speech impairment) using a TTY/TDD and a Hearing person using a telephone. Either party can initiate a call by dialing the relay operator's toll free number and requesting the operator to place a call. On the surface, TTY/TDD technology appears to solve telecommunication problems of people who are Deaf and Hard of Hearing, and the system has been widely accepted as a viable means of communication among people with hearing loss and people who are Hearing. This system is still in operation; however, it is not without its own set of operational, linguistic, and cultural drawbacks.

Operationally, TTY/TDD systems are a one-way mode of communication. In a one-way communication system, the receiver of the message must wait until the sender of the message is finished speaking or typing and gives a signal indicating they solicit a response. This feature has become particularly problematic with the increased use of computer-generated answering menus and answering machines, which do not usually allow enough time for the person to

make a selection and respond, resulting in their being unable to access information or utilize services over the telephone (Grossman, 2001; Nelson, 1996). In addition to such operational drawbacks of TTY/TDD systems, other even more critical deficits exist in the areas of primary language and social context and culture (Colonomos & Bienvenu, 1992).

Many Deaf and some Hard of Hearing people find English difficult to learn. While people who hear well learn language primarily by hearing those around them speaking, the ability to hear speech is not available or is seriously restricted for Deaf or Hard of Hearing learners. For individuals whose Hearing loss occurred before the acquisition of speech, English is effectively a foreign language. Additionally, because the acquisition of reading skills is so dependent on Hearing the language spoken, many Deaf and Hard of Hearing people have English reading skills at the third grade levels or less, making TTY/TDD use difficult (Elliot, 1987; Holt, Traxler and Allen, 1997).

Another critical problem of TTY/TDD communication systems for the Deaf and Hard of Hearing is the lack of the ability to help express the emotional content of a conversation. The intricate hand motion details, facial expressions, and positioning of the head and the body typical of signed communication serve to convey nuances of

meaning, thought, and expression. However, these nonverbal cues are necessarily absent in written communication and so the conceptual expressions of ASL users cannot reliably be described adequately (Grossman; 2001; Nelson, 1996). Language often is an important part of one's cultural identity. Although not all Deaf persons in the United States use American Sign Language, ASL still must be considered the single most important element that binds the Deaf community together. ASL is a visual/gestural language as opposed to an aural/oral language with it's own phonology, morphology, and syntax (Valli & Lucas, 1995). But perhaps the most serious sociocultural deficit of relay communication systems for the Deaf and Hard of Hearing lies with the device itself and the assumptions behind the device. As a voice and text-based system, it accepts the primacy of Hearing people's preferred communication methods. Attempts to make Deaf/Hard of Hearing people fit the Hearing world has been strongly opposed by the Deaf culture (Smart, 2001), and the use of text-based systems of communication has been seen as oppressive and as a denial of Deaf culture (Deaf and Hard of Hearing Access Program, 2004). Hoffmeister (1996) pointed out that many of the professionals working with Deaf and Hard of Hearing people continue to view Deafness as pathological by focusing only on the Hearing loss. This pathological view is in stark

contrast to the view of the Deaf community, whose members see themselves as cultural and linguistic minority rather than as disabled (Hoffmeister, 1996). Tomasetti (1981) and Ebert & Heckerling (1995) have argued that communicating in ASL with a person who is Deaf or Hard of Hearing and uses ASL as their native language or language of choice is best for fostering comprehension and honoring cultural differences. Today, new communication technologies that employ visually based relay communications are offering that option.

Video Relay Services

Video Relay Services (VRS) have recently emerged as a possible alternative to TTY/TDD relay service communication. VRS is a visually based communication system requiring a minimum of three basic components: a video monitor such as a television or computer screen, a video camera, and high-speed broadband DSL line. Using the system, people who use manual languages like ASL are able to see an interpreter on a monitor. Like the TTY/TDD system, VRS uses a third party relay operator. However, in the VRS system the relay operator (who is actually an interpreter) and the person who using manual language are in view of each other through cameras linked to monitors and can therefore communicate manually.

As with the Relay system, an operator communicates with the Hearing party over the telephone line. The operator is able to provide two-way communication and express the emotional content of all of the people involved in the call, which helps return the natural flow to conversation. As trained and qualified interpreters, the relay operators project the emotional context as presented by both parties using appropriate facial expressions and body language (McEntee, 1995). The VRS system can also be operated with a videophone, allowing everyone on the call to use manual communication directly with each other. So, Deaf or Hard of Hearing people can call each other, and once connected have a private conversation with no intermediary. To operate the videophone, two different components are needed: the monitoring hardware and a cable service. Currently, each part must be purchased separately. Once the system is in place, the user turns the unit on, follows the directions on the screen and communicates with a VRS signing operator to connect the call (Personal communication, D. S. Coco, January 9, 2004).

The VRS system can be used to facilitate communication between people who use manual languages and people who use speech. Using videophones, VRS can also be used among people who use manual languages. Given the variety of available technical options and cultural sensitivity of

VRS, it seems reasonable to think that Deaf and Hard of Hearing people would fully embrace the use of VRS communication (Grossman; 2001; Nelson, 1996). However, some anecdotal reports from Deaf communities suggest that that has not occurred (Personal communication, D. S. Coco, January 9, 2004).

Adoption and Discontinuance of AT

A growing body of research suggests that it may not be enough to simply develop technologies to meet functional needs. People often discontinue or reject high quality, well-designed, useful technological tools (Day & Jutai, 1996). Discontinuance rates of nearly all types of AT are exceptionally high; some research suggests that up to 75% of communication technologies are discontinued—most of them within the first three months of attempted use (Bat-Chava, Deignan & Martin, 2002; Galvan & Scherer, 1996; Scherer, 1996). But why is useful AT being abandoned? Occasionally, assistive technology is discontinued because the condition that resulted in the need for it has improved (Cushman & Scherer, 1996). Alternatively, AT devices may produce stigma by bring unwanted attention and may hinder a person's ability to fit in with one's peers or in the general public and are therefore not used. And devices that requires more energy or greater effort to use are less likely to be adopted than less demanding alternatives

(Heinemann, Magiera-Planey, Schiro-Geist, & Grimes, 1987). Jutai (1999) stated when AT helps the user feel able, confident, and motivated to explore possible uses, the AT will have positive psychosocial impacts on the user, and is more likely to be adopted and retained.

When considering assistive technology adoption, it is important to recognize that adoption exist on a continuum, from rapid acceptance to complete rejection. Sometimes, a technology is adopted, only to be discontinued later. (Rogers, 2003). Riemer-Reiss and Wacker (2000) have suggested that some concepts of Roger's theory of diffusion of innovations can provide rehabilitation professionals an overarching philosophical framework regarding the processes around adopting, using, discontinuing, or fully rejecting technology, including assistive technology. Selected features of Rogers' theory are discussed in Chapter 2 Literature Review and serve as a conceptual structure for understanding and interpreting the research results the current study.

Measuring Technology Adoption

Given the consequences to both the hearing community and people with hearing loss, there is a need for strategies to improve the use and retention of assistive devices to facilitate communication (Fonn, 1996; Olkin, 1999; Bat-Chava, Deignan & Martin, 2002). Thus far,

research suggests that despite the functionality of a device, people are not likely to adopt and use AT if they do not feel it will improve their quality of life, their psychological well-being, independence, self esteem, sense of control and empowerment (Gitlin, 1996; Day & Jutai, 1996; Day, Jutai, & Campbell, 2002).

One of the first AT adoption measures was the Human Activity Assistive Technology Model (HAAT). It placed more focus on the individuals' actual capabilities and the completion of the task at hand in the context of the social setting, rather than on remediation of the person's limitations to fit the capabilities of the AT (Cynkin, 1979). This early model took into consideration the need for others to be involved in the design and selection of AT, including medical professionals, rehabilitation counselors, employers, family members, and most importantly, the individual with a disability needing some sort of AT to complete a task (Cynkin, 1979)

In response to the continuing need for a useful assessment tool, Scherer (1991) designed the Matching Person and Technology Model (MPT). The Matching Person and Technology instrument has a variety of assessment options, including pencil and paper tests ranging in length from 15 to 45 minutes. A critical feature of Scherer’s research is that she considered not only how to select the most

appropriate AT device for an individual but also how best to follow up with the consumer.

Fuhrer, Jutai, Scherer, and Deruyter (2003) report that while the AT industry has seen remarkable growth in recent years, corresponding outcome assessments have not kept pace. The authors note a number of factors are contributing to the dearth of valid outcome measures, including; the sheer numbers of devices in use and resultant difficulty tracking them, an acceptance of anecdotal evidence of AT usage and success, a focus on only the technical aspects of devices without evaluation of user experiences, the lack of mandate from various stakeholders for accountability, a belief that technology benefits must be obvious and easily observable, and the absence of well-developed theory about AT use, adoption, and discontinuance (Fuhrer, Jutai, Scherer, & Deruyter, 2003). Historically, the few AT outcome measures available were medically oriented and designed primarily to assess health status (Day & Jutai, 1996). Such measures are not appropriate for some types of AT, and are not relevant to certain populations.

Development of PIADS

In response to the absence of AT outcome measures that are responsive to quality of life issues, Day and Jutai (1996) designed the Psychosocial Impact of Assistive

Devices Scale (PIADS) based on extensive research with the Pleasure-Arousal-Dominance Scale, personality research literature, and qualitative focus groups. The PIADS instrument was used in the current study, and is discussed in much greater detail in Chapter 3 Methods. The body of literature pertinent to PIADS development is included in Chapter 2 Literature Review. Briefly, the PIADS is a 26 item self-reported assessment of the impact of AT on independence, well-being and quality of life. Each item is rated from –3 to +3, were the negative denotes a decrease in psychosocial functioning, zero is neutral and +3 indicates an increase in psychosocial functioning. The PIADS also includes three subscales, with descriptors of competence, adaptability, and self-esteem (Jutai & Day, 2002). The PIADS was designed to capture the experience of AT usage from perspective of the AT user, and thus provide a tool for evaluating the psychosocial impact of the device on the user.

Purpose of the Research

Barriers to communication for people who are Deaf and Hard of Hearing can result in social and familial alienation, low literacy levels and limited educational opportunities, difficulties in obtaining vocational rehabilitation services, and unemployment or underemployment. Communication barriers between Deaf and

Hard of Hearing persons and Hearing people cost the U.S. economy an estimated $56 billion annually in lost productivity and costs of special services (Better Hearing Institute, 1999). Add the untold cost of assistive technology that is acquired the abandoned, and the economic impact grows even more staggering. Considering both the high annual cost of communication barriers to the economy and the recent budget restraints facing state and federal service providers and, it is important to develop an understanding of the reasons for adoption and discontinuance of AT prior to providing such services, allowing for better use of limited funds (Gelderblom & de Witte, 2002).

While some researchers have addressed the issue of assistive technology adoption and discontinuance for persons with physical disabilities, no studies were found which address video relay services (Seeger & Fisher, 1982; Scherer & McKee, 1989; Garber & Gregorio, 1990; Gray, Quatrano & Liberman, 1998). Little is known about the response of Deaf or Hard of Hearing people to VRS and their interest in adopting it as a communication technology. Also, it has been noted that AT adoption exists on a continuum, and outcomes are rarely dichotomous (Riemer-Reiss & Wacker, 2000; Rogers 2003). A more responsive way of categorizing psychosocial outcomes is needed; adopter

categories as described by Rogers' theory provide a useful framework.

Therefore, the purpose of the current research is to determine if people who are Deaf or Hard of Hearing adopt VRS in a manner consistent with adopter categories described in Rogers' theory of diffusion (2003). Specifically, the research was designed to explore whether psychosocial and demographic variables discriminate adopter categories of Deaf and Hard of Hearing Adults with respect to VRS. The framework of Rogers' theory (2003) assists in showing more detailed categorical outcomes to help predict adoption or rejection of VRS with a Deaf or Hard of Hearing population.

Null Hypotheses

Psychosocial and demographic variables will not predict across four levels of adoption of video relay services. Stated more technically, linear combinations of psychosocial and demographic variables will not discriminate among four levels of adoption of VRS assistive technology.

Summary

Although more consideration has been given in recent years to developing and distributing useful AT, technology adoption rates have not improved. Many devices are discontinued in their first year of use, and discontinuance

rates have been documented as high as 75%. Problematic design, failure to consider the opinions of users in developing AT, difficulties in obtaining the technology, failure of the technology to meet user expectations, and changes in the needs or wants of the user are all linked to discontinuance rates (Day, Jutai, & Campbell, 2002; Preston, 1994). Particular to Deaf and Hard of Hearing people, much of the currently available communication technology reflects a lack of understanding of the group's linguistic and cultural preferences.

Psychosocial factors appear to have significant impact on how a person evaluates his or her own functional capacity and how AT can maximize that capacity. People tend to assign personal meanings to AT and these meanings are critical to whether a person successfully includes AT in his or her life (Gelderblom & de Witte, 2002; Pape, Kim, & Weiner, 2002). Complex and often difficult to quantify considerations also come into play, such as the degree to which a device preserves self-image and effectively ameliorates functional limitations (Day, Jutai, & Campbell, 2002).

CHAPTER II LITERATURE REVIEW

As previously discussed, assistive technology (AT) has been documented to provide positive benefits to people with disabilities. Nonetheless, a problematic issue remains- a large percentage of AT devices purchased are never adopted by intended users (Cook, & Hussey, 1995; Bryant & Bryant 2003). Consideration of psychosocial benefits for AT users has been suggested as a critical evaluative step prior to purchasing AT in an effort to improve technology adoption rates (Fellendorf, 1983; Phillips, 1993; Pape, Kim, & Weiner, 2002; Stickel, Ryan, Rigby, & Jutai, 2002). The purpose of Chapter 2 Literature Review is twofold. First, this chapter serves to review articles related to types of communication AT for people who are Deaf or Hard of Hearing, to evaluate the literature related to adoption and discontinuance of AT, and to review the literature base related directly to the validation of the PIADS.

Additionally, this chapter provides some baseline context for not only for the literature reviewed, but also for the theoretical framework used in the discussion of the study results. To do so, the chapter begins with an historical overview of assistive technology for people with disabilities and concludes with a review of Roger's (2003) Diffusion of Innovations Theory, which is presented in

Chapter 5 Discussion as an underlying framework for organizing and interpreting the results of the study.

Several search methods were employed in compiling sources for the literature review. The University of Texas at Austin's library catalogs; the ERIC databases and the OVID PsychInfo database, EBSCO, and Academic Search Premier were searched electronically. Additionally, a hand search of The University of Texas at Austin's library catalogs was undertaken for older titles and materials. A variety of search terms were used singly and in combination: Assistive Technology, TTY, TDD, Telecommunications, Video Relay, Deaf, Hard of Hearing, adoption, discontinuance, psychosocial, Diffusion of innovations, technology, and disability.

Initial searches necessitated further investigation. Secondary searches included the following search terms: Psychosocial Impact of Assistive Device Scale, Real Time Graphic Display, Computer Assisted Remote Transcription, and communication hardware and software. Selection standards were applied to manage the scope of the review. Many articles located during the literature search process were anecdotal in nature or from non-refereed sources and were therefore not included in the chapter, unless the article offered information or perspective especially significant to the topic.

In general, search results indicate that assistive technology and discontinuance of AT are represented in the body of literature. However, in keeping with a lack of research previous noted by Stickel, Ryan, Rigby, and Jutai (2002), and Pape, Kim, and Weiner (2002) less empirical research is available related to the psychosocial impact of AT. No specific literature on the relationship of psychosocial factors to AT use/adoption in the Deaf and Hard of Hearing communities was found (Seeger & Fisher, 1982; Scherer & McKee, 1989; Garber & Gregorio, 1990; Gray, Quatrano & Liberman, 1998). In order to provide greater context for the literature review to follow, a brief historical overview of assistive technology for people with disabilities is presented.

Historical Overview of Assistive Technology

Bryant and Bryant (2003) suggest that the history of assistive technology may be divided into three distinct chronological sections: a) the Foundation period dating prior to the 20th century, b) an Establishment period from about 1900 into the early 1970's and c) the Empowerment period, which 1973 to present. The significant events and time lines of each era are important to an understanding of AT today, and each warrants attention (Bryant & Bryant, 2003, Cook & Hussey, 1995).

The Foundation Period

Early AT of the Stone Age may have been sticks and other natural items used to assist people with continuing their daily activities after experiencing acute injuries or long-term physical disabilities, thus beginning the Foundation Period of Assistive Technology (Cook & Hussey, 1995). Documentation of post surgical AT for maintaining daily life activities has been dated as early as 600 CE (common era), and using AT to maintain daily life skills for persons with disabilities was the focus of the early medical community until approximately the seventeenth century. Only then did physicians begin considering not only how the AT would maintain or restore functioning, but also the causal relationships among various physical and mental disabilities and the variety of limitations that resulted (Cook & Hussey, 1995).

As America entered the nineteenth century, a number of factors and events served to further development of AT. In general, public health campaigns and increasing concern for the education for people with disabilities became an impetus for the development of AT. This was a time when people began to be concerned that people with disabilities were able to survive injuries, carry out activities of their daily life, and become educated. In addition, technological developments and inventions designed for the

military and for the general public were appropriated for persons with disabilities. Louis Braille is a notable example. Around 1834, Louis Braille presented a method of reading for people who are blind which had been originally designed so French soldiers could read at night. The Braille method is still in use today (Bryant & Bryant, 2003). Other important innovations included Thomas Edison's invention of the phonograph, 1877; and the opening of the American Printing House for the Blind, 1879. The final major development for people with disabilities of the Foundation Period was the Braille typewriter of 1892 (Smith, 1998; Bryant & Bryant, 2003).

In addition to changes in public opinion and broader technological innovations, soldiers returning from the American Civil War sparked keen interest in the development of wheelchairs and prosthetic devices. The Foundation Period can be summarized by noting that from early pre-historic documentation until the close of the nineteenth century, important steps were taken to lay the groundwork for more modern developments in AT. This period also marked the beginning of a movement to study causal factors of physical and neurological disabilities (Bryant & Bryant, 2003).

Establishment Period

The Establishment period was much shorter in duration than the Foundation Period, lasting only from around 1900 to 1972, and marked the beginning of a change in attitudes about disabilities, from a medical perspective to a more psychosocial framework (Wright, 1983). Within this new framework, disability-specific organizations assisting individuals with civil rights issues began to emerge, drawing attention to the need for rapid development of AT for people with disabilities (Bryant & Bryant, 2003).

In 1918, Congress passed the Smith-Sears Veterans Rehabilitation Act, P.L. 65-178 (Soldier Rehabilitation Act of 1918, 40 Stat. 617), which was implemented to assist war veterans with disabilities in regaining their functional life in the civilian world. Two years later, the services of this act were extended to all citizens with disabilities through the Smith-Fess Citizens Vocational Rehabilitation Act, P.L. 66-236 (Vocational Rehabilitation of Persons with Disabilities in Industry Act of 1920, 41 Stat. 735). The legislation marked a shift in focus from the disabling condition to the residual functioning of the individual and their specific attendant factors (Bryant & Bryant, 2003; Jenkins, Patterson, & Szymanski, 1987).

As with the Foundation Period, some of the momentum developed in the Establishment Period can be partly

attributed to the strife of war, especially World Wars I and II, the Korean Conflict, and the Vietnam War. Not only were the wars partly responsible for the growing numbers of people with disabilities in the United States, but also the war survivors expected to be able to participate in their pre-disability lives as much as possible. The Rehabilitation Amendments of 1973 (P.L. 78-113), provided disability-related training funds for medical professionals, thus triggering advancements in medicine and AT such as battery-operated hearing aids (Barden-LaFollette Act of 1973, 29 U.S.C. ss. 31 *et seq*; Bryant & Bryant, 2003). The momentum of the Establishment Period continued to build up to the beginning of the Empowerment period (Scherer, 1993; Bryant & Bryant, 2003).

The Empowerment Period

Running from 1973 to present, the onset of the Empowerment Period was marked by the passage of key disability-related legislation The Rehabilitation Act of 1973, or P.L. 93-112, (Rehabilitation Act of 1973, 87 Stat. 355, 29 U.S.C. ss 701 *et seq*.; Bryant & Bryant, 2003). Section 504 of The Rehabilitation Act of 1973 prohibited entities receiving federal funds from discriminating on the basis of disability, and also addressed "auxiliary aids" -- in other words, assistive technologies. Today, any entity covered under Section 504 must provide the necessary

auxiliary aids to assure that people with disabilities receive the same benefit and access to the same programs as their non-disabled peers (Bryant & Bryant, 2003).

Shortly after the passage of The Rehabilitation Act of 1973, P.L. 93-112, The Education for All Handicapped Children Act (EAH), P.L. 94-142, (20 U.S.C. ss 1400 *et seq*.) was passed. This 1975 law stated that all children regardless of disability receive a free and appropriate public education. The "appropriate education" section of the law sparked a rapid growth in AT for school-aged children with disabilities as schools scrambled to meet student needs and the letter and spirit of the law. The EAH amendments of 1985, now known as the Individuals with Disabilities Education Act (IDEA), further strengthened provision of AT to students with disabilities (Individuals with Disabilities Education Act of 1990, 20 U.S.C. ss 1400 *et seq*.).

Even more recently, The Architectural Barriers Act of 1986 (42 U.S.C. ss 4151 *et seq*) and the recently reauthorized 1988 Technology-Related Assistance for Individuals with Disabilities Act, P.L. 100-406, (29 U.S.C. ss 2201 *et seq*.) both addressed consideration of using AT for individuals with disabilities (Bryant & Bryant, 2003). The latter act was reauthorized in 2004 (H.R. 4278). The reauthorization focused specifically on obtaining the

necessary AT for people with disabilities working and living in the community (Bryant & Bryant, 1998; Bryant & O'Connell, 1998). The Americans with Disabilities Act of 1990 (42 U.S.C. ss 4151 *et seq.*) expanded Section 504 of The Rehabilitation Act of 1973 and applied it to all public and private entities regardless of receipt of federal funding (Wise & Olson, 1994; Bryant & Bryant, 2003).

During the Empowerment Period the number of people and the average life expectancy of people with disabilities has risen significantly due in part to advancements in medicine and disability research (Bryant & Bryant, 1998; Bryant & O'Connell, 1998). Increasingly, persons with disabilities enjoy the same rights and responsibilities as any other citizen. Advocacy groups and legislation have been developed to support both specific and collective needs. The main focus of the Empowerment period remains obtaining the education, disability rights, and AT to live and work in society (Wise & Olson, 1994; Bryant & Bryant, 2003).

Summary

A review of the Foundation, Establishment, and Empowerment developmental periods of assistive technology can foster greater understanding of the various technological, legislative, and cultural concerns related to current AT options (Bryant & Bryant, 2003, Cook & Hussey, 1995). Growing out of the industrial revolution

through entrepreneurial inventiveness, AT rapidly became governed by legislation. People with and without disabilities have reaped significant benefit from mandated public access to AT, and the disability rights movement have been a driving force behind state and federal laws and funding (Cook & Hussey, 1995; Wise & Olson, 1994).

Assistive Communication Technologies

This section of the literature review considers three relevant categories of telecommunication systems used by Deaf and Hard of Hearing people. First, literature related to TTY/TDD systems is discussed. Next, selected articles related specialized telecommunication systems that are available as alternatives to TTY/TDD are reviewed. Articles that merely announced availability of new systems or reported on prototypes or experimental systems were not reviewed. Finally, the emerging literature addressing Video Relay Service is reviewed. In this section, it is critical to note that little scholarly research exists related to telecommunication systems for the Deaf and Hard of Hearing.

TTY/TDD

Kelleher (1991) researched TTY/TDD confidentiality requirements and concern in response to the ADA and the widening of TTY/TDD availability and concerns over confidentiality. The author noted that while operators may not reveal the content of any calls, few measures are in

place to ensure they comply with the critical questions about how to balance the rights of the deaf and the efforts of law enforcement. The author concluded that full confidentiality is a must to give Deaf and Hard of Hearing people the same rights as hearing people. The mandate for full access can only be successful if full citizen rights are included.

Kukich (1992) conducted an exploratory study on call setup, operator errors, and speech generating options using TDD and the Bellcore Telecommunications Network for the Deaf (TND). The author was especially interested in options to allow the use of speech synthesizer with the TDD system, rather than a human operator. It was noted that the numerous spelling errors made by deaf of Hard of Hearing users effectively prohibited the direct use of a speech synthesizer. Research findings indicated that about 60% of typing errors would be identified by the system as “non-words”. The TND system has strict text-to-speech spelling requirements, and would be useful only if a human operator corrected the typing and spelling errors prior to use of the synthesizer. Even then, Kukich (1992) noted that the accurate error correction rate could remain low… around 50%.

Moving away from the technical aspects of TTY/TDD systems, Mozzer-Mather (2002) conducted a study of the

linguistic properties of TTY conversations. As discussed in the previous chapter, the TTY system only allows one person to respond at a time. Yet in both spoken and signed communications, people rarely take such formal turns conversing. Analyzing 202 typed TTY conversations ranging in length form 5 minutes to one hour, the author found documented a wide variety of types of discourse, including storytelling, arguing, question/answer pairings, and directives. She also noted the presences of a number of typical speech acts, such as complaints, corrections and admonishments, and greetings and farewells. An especially critical research finding indicated that Deaf TTY users employ complex conversational strategies including multi-topic turns, back channel responses, and discourse markers used to keep place in a conversation in what the author terms a "functional fusion" (p. 278).

Specialized Systems

Following the development of TTY/TDD systems in the mid-1960's, technology developers and Deaf and Hard of Hearing people quickly began looking for alternative and better-performing systems (Houde, 1979; McCoy & Shumway, 1979). Real Time Graphic Display of Speech (RTGD) and Computer-Assisted Remote Transcription (CART) are terms used (often interchangeably) to denote systems that use a stenographer to convert spoken English into print in a

manner similar to captioning on television. When the terms are not used synonymously, RTGD generally refers to a system in which the stenographer, the speaker, and the person needing the captioning are all in the same location. Conversely, CART more often refers (as the name implies) to transcription that occurs from a separate location.

Tomasetti (1981) conducted early research on the use of captions to improve retention rates in the area of cognition and psychomotor activity of Deaf students. He compared several formats for presenting materials to Deaf students whose primary language was ASL, including captioned video, signed video, and signing by a human interpreter. Results indicated that participants using the interpreter and participants using signed video scored better on a cognitive posttest than the captioned video group. The participants using the interpreter and participants using signed video also scored significantly higher on discrete psychomotor abilities than the participants using the captioned video. The author concludes that the optimum method for presenting materials to people whose primary language is ASL is in ASL by a live interpreter.

Also interested in the use of captioning in the classroom with Deaf students, Stuckless (1983) studied student preference for Real Time Graphic Display of Speech

(RTGD) versus American Sign Language (ASL) provided by a human interpreter. Stuckless (1983) found that students whose primary or native language was ASL preferred the ASL interpreters in class, while the students whose hearing loss occurred post-lingually preferred the RTGD. The study also found that stenographers of RTGD were more accurate in their translation than the ASL interpreters were. Interestingly, accuracy did not affect preference between ASL interpreters and RTGD.

In a more recent study of RTGD, Steinfeld (1998) considered whether real time captioning could be beneficial to both Deaf/Hard of Hearing and Hearing college students. Results of the research were positive; both Deaf/Hard of Hearing students and Hearing students demonstrated improved lecture recall accuracy using RTGD. The study is especially valuable in that it assessed adults rather than children. Steinfeld noted that the Deaf and Hard of Hearing students in this study all had good oral skills, needing only occasional finger spelling to communicate well with the researcher. Therefore, it may not be possible to generalize the results of this study to more severely and profoundly Deaf students.

Taking an employment oriented focus, Preminger and Levitt (1997) investigated the use of RTGD/CART in a work setting. Noting that difficulties in meeting participation

are a key barrier to employment and advancement for people who are deaf/Hard of Hearing, the authors were interested in the effectiveness of RTGD/CART in transcribing a group meeting with multiple speakers. Results indicated overall good accuracy in meeting transcriptions. Transcription problems that were noted included omission of words and phrases and inaccuracy in words and phrases. Accuracy decreased as number of speakers increased. The researcher also found that difficulties in setting up and using the RTGD/CART system frustrated users, making them less likely to use the system. Space demands of the system crowded the meeting room and decreased comfort for meeting participants. The authors suggested that in order for the CART system to be effective in the work place, the people who use it must know how to set it up correctly and employ skilled, accurate stenographers. They further recommended software development to alleviate the problems of context errors in the transcriptions.

Moving into exploration of even higher-tech communication options, Mackhall (2004) studied applications and outcomes of the SMART Board interactive whiteboard and SynchronEyes software. The SMART white board is a large screen that connects to a desktop or laptop computer and can be positioned in front of the room. A user can write with a finger or a stylus over any computer application and

have the writing superimposed onto the screen. By positioning the SMART Board in front of the room, a presenter can maintain face and eye contact with the audience, since he or she does not need to turn either write on the screen or see what has been written. SynchronEyes software allows a person to monitor multiple computers and screens, such as in a computer training session or computer lab. The program allows a person to stop all mouse and keyboard functions of connected computers and cause either a blank screen to appear or a screen with a request, such as “Please look up”. For example, a teacher could use the program to gain the attention of Deaf students working at computers in a classroom. The study took place at the Kendall Demonstration Elementary School and the Model Secondary School for the Deaf (KDES and MSSD) after finding that only a few teachers had any familiarity with available communication systems. Mackhall (2004) found that teachers who used SMART Board and SynchronEyes feel classes are more productive and students have better understanding of concepts presented. The study also found that classroom success of the communication technologies resulted in increased technology use and new, creative ways to use the technology. Teachers demonstrated innovative use of the

communication tools, spontaneously using the tools to communicate with other professionals and with parents.

Video Relay Service

Along with captioning systems, Video Relay Service is a growing alternative to TTY/TDD. To recap, VRS is a visual communication system developed by Sorenson Media. First available only two years ago, VRS enables people who use manual communication to converse with either Hearing or Deaf/Hard of Hearing people via a camera, monitor, and human sign interpreter. Very few studies exist as of yet related to VRS. But, similar to the concerns raised about TTY/TDD systems just after the passages of the 1990 Americans with Disabilities Act (ADA), concerns about access, privacy, and usage are now being raised about VRS.

Robitaille (2004) reviewed the current Federal Communications Commission (FCC) standards and policies related to VRS. The author notes that the location of the VRS user is a critical component of the FCC determination of compliance with Title IV of the American with Disabilities Act (ADA). Although the FCC considers VRS to be functionally equivalent to an ordinary telephone call, is also says that VRS can only be used for phone between parties in separate locations—not for use in the workplace with co-workers. According to the FCC, a Deaf or Hard of Hearing person can use VRS at home or at work to make calls

outside those environments, it cannot by used to make calls within environments. Robitaille (2004) suggests that some FCC oversight of VRS is useful and appropriate. Policies help maintain high technical standards, stringent network security, and ensure continual access to expert sign language interpreters.

Swedish researchers Gotherstrom, Persson, and Jonsson (2004) conducted a recent study to evaluate VRS satisfaction and to compare VRS with Text-based phone relay service in the areas of cost, quality of service, and quality of life outcomes. Across all areas, participants demonstrated preference for the VRS over text-based services, despite the slightly higher cost of the equipment. Participants noted that the quality of the service was faster and more professional using the VRS system, and reported greater positive impact on their quality of life. The small study group of 41 participants posed possible limitations. Also, findings related to Swedish users may not have relevance to people in the United States due to language and culture differences.

Summary

Various systems have been investigated as viable alternative to TTY/TDD. Technologies to improve communication between deaf and hearing people, such as Real Time Graphic Display captioning (RTGD), Computer Assisted

Remote Transcription (CART), and high-tech peripherals and software have met with varied success (Crammatte, 1967; Mowry & Anderson, 1993). Despite some promising findings, concerns about accuracy, cost, and availability of these systems remain and few are in wide spread use (Sokol, 1994). In additional, most specialized options such as those reviewed here require strong reading skills which many Deaf and Hard of Hearing people do not possess.

Assistive Technology Adoption

Assistive technology outcomes exist on a continuum, from rapid acceptance to complete rejection. Sometimes, a technology is accepted then discontinued later (Rogers, 2003). A number of factors have been linked to AT outcomes, including stakeholder awareness of available products and involvement in the AT selection process. Additionally factors that also have impact include changing technology needs due to changes in medical or functional status, satisfaction with performance of the device used, and responsiveness to personal, social, and cultural considerations (Cushman & Scherer, 1996; Heinemann, Magiera-Planey, Schiro-Geist, & Grimes, 1987).

Fellendorf (1983) investigated the speed with which AT is adopted, citing a lack of awareness of available products and scant information about their use as reasons for typically slow adoption rates. He found that adoption

of useful assistive technology was slow because information on available technology was not readily available to service providers or to the people with disabilities intended to benefit from AT. A serious limitation of this study is the researcher's narrow focus information dissemination related to AT Other factors, such as the psychosocial impact of the devices on their potential beneficiaries and the reliability and durability of previously utilized devices, were not addressed. The study may be further limited by the author's assumption that responsibility for slow or reluctant adoption lies with consumers and providers rather than with flaws in the device.

Like Fellendorf (1983), Scherer (1991) suggested that lack of information and awareness was a key cause of AT discontinuation or disuse. However, the author recognized that other factors played a role too. She noted that by taking into account the amount of information provided to the potential user about the features and uses of the AT, the consumer's identified needs, and social, cultural and environmental factors, the likelihood will be increased for a positive match and acceptance of the AT. The author outlined three factors required to determine an appropriate match between a technology and the person considering the

technology in the areas of psychosocial setting, personality, and technology.

Phillips and Zhao (1993) and Gitlin, Levine and Geiger (1993) also researched the possible reasons for AT discontinuance. Phillips and Zhao (1993) discovered that 29% of respondents discontinued their AT in the first year of use. The highest rates of discontinuance were noted during the first and fifth years of use, with four major concerns identified, such as the user's opinions not being considered, obtaining the device was too difficult, the device not performing as expected, and the user's needs changed. Gitlin, Levine and Geiger (1993) found similar factors related AT discontinuance. These authors noted that in some instances the prescription given for the device was not actually needed, the AT was too difficult to use, and that the At had been lost or become inoperable. It is important not only for the person with a disability to be involved in the decision- making process, but it should also not be difficult for them to obtain the prescribed AT when working with an agency (Gitlin, Levine & Geiger, 1993; Phillips & Zhao, 1993).

Following up on earlier studies, Goodman, Tiene and Luft (2002) suggested that more family and community support needed to be available to assist people with disabilities adopt technology. Concerned about a gap in

performance between students with disabilities and students without disabilities, these researchers questioned which factors influenced college students with disabilities. In particular, research focused on the impact of enrollment in an adaptive computer training course on use of AT. The results showed that 75% of the students in the study utilized some form of assistive technology as a result of participating in the class. However, the authors report limitations due to innovation bias in the study and recommended further studies being conducted with different disability groups, ages, and education levels.

Taking a consumer-focused approach, Phillips (1993) proposed that consultation with the person considering AT was a positive aspect of selecting AT for people with disabilities. The author stated that professionals in the field of rehabilitation have responsibility for problems with use and retention of AT. The solution suggested includes a “consumer-focused” model of providing assistive technology. In this model, the consumer with a disability and/or their representative have the most say in what is purchased and why. It was proposed that the person with a disability have the full ability to make informed choices about AT. Clients would not just be provided with a laundry list of possible options, but would have access to information for each device under consideration such as

cost, availability, and ease of maintenance. Also, they would be given the opportunity to consider the psychosocial and other aspects of the assistive technology before making a decision to accept the device. The author theorized that if service providers allow the person with a disability to make fully informed choices, a reduction in the AT discontinuance rates will occur.

Hocking (1999) and King (1999) both addressed the benefits of AT in the areas of functional independence, employment, and overall quality of life. They agree that low rates of AT adoption could be related to minimal attention to the psychosocial aspect of AT. King (1999) noted most AT devices were mass-produced; however, specific attention to the ability for adaptation and modification for individual users should be considered during AT production and there are key human factors which need attention in order to make a proper selection of AT with an individual. King (1999) listed the key human factors as: (a) ease of control of the device, (b) efficiency of the device, (c) the effectiveness of the device, (d) comfort for the user, and (e) reducing the danger to the user or others around them. He further noted the importance of paying careful attention to the negative aspects of the AT to avoid any possible injury or discontinuance due to unmet user expectations. Hocking (1999) stated that more focus is

placed on training and follow up of AT in an attempt to increase adoption rates. She suggests that a person's broad perception of identity as a person with a disability must be taken into consideration when selecting AT. When assisting someone with the adoption of an AT device, careful consideration should be given to the person's self-image, cultural sensitivities and social identity. The provider should be alert as to when and if a person with a disability is ready for the AT and should provide the necessary information to help facilitate the adoption of the AT (Hocking, 1999; King, 1999).

Riemer-Reiss and Wacker (2000) questioned whether AT discontinuance factors are closely linked to Rogers' (1995) diffusion of innovation theory, which identifies discontinuance as due to one of two general factors: disenchantment or replacement. Rogers (1995) diffusion theory further states that compatibility, trialability, and observability of an innovation are positively correlated to adoption. In other words, the more people see other people using the device and the more opportunity they have to test the device, the more likely they are to adopt the innovation. Their findings were consistent with previous literature supporting Roger's (1995) theory – the more involved an individual is in selecting the assistive device the more likely they are to continue utilizing that

technology. The authors further suggest studies be conducted on discontinuance based on age, gender, education level and disability.

Returning to the notion that high AT discontinuance and rejection rates are due to lack of information, Andrich and Besio (2002) stated that better educational programs about AT are needed. The authors suggested that targeted educational efforts would produce more informed choices that could lead to a reduction in AT discontinuance and reduced wasted effort and resources. The research findings supported awareness and knowledge as the primary factors in consumer use of AT and in improving their quality of life and avoiding AT discontinuance. The authors concluded that it is not enough for a person to receive a prescription for an AT device base on medical and physical information; the psychosocial effects of the device on the person must be accounted for.

Using a qualitative method, Kittel, DiMarco, and Stewart (2002) investigated discontinuance rate of AT by three people who used wheelchairs and had discontinued use of their device within the first year. The participants who discontinued their wheelchairs reported that they did not understand the impact it would have on the psychosocial factors (a) sense of independence, (b) self worth, (c) social acceptance. The suggestions made in the study are

consistent with those made in the previous article Andrich and Besio (2002)— communication and education were the primary themes in reducing discontinuance rates. The participants requested meetings with the manufacturers, others with similar disabilities, the medical staff prescribing the chair, and more time to adjust to using the particular chair in their environments before making the final decision. The authors suggest that further study of people who did not abandon their wheel chairs would help identify positive factors which resulting adoption of AT.

Other authors have chosen to investigate the role service providers have in AT adoption and discontinuance. Stickel, Ryan, Rigby and Jutai, (2002) were concerned with the difficulty some people with significant disabilities face when trying to convince a service provider of the need for assistive technology due to the high cost and high known rates of discontinuance. Attention was also given to a cost comparison between people living in institutions without Electronic Aids to Daily Living (EADL) and those who live independently, citing the monetary benefits associated with people who live independently. They questioned 40 people with significant disabilities using EADL twice, six months apart and administered the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST) (Demers, Weiss-Lambrou, & Ska, 1996) and the

Functional Measure of Independence (FIM) (Dodds, Matrin, Stolov, & Deyo, 1993). They suggest that the people in the study were relatively pleased with the impact the EADL had on their lives; however, some dissatisfaction with cost of maintenance was noted. They further suggest that user satisfaction in conjunction with instruments that measure the psychosocial impact of AT can help people select appropriate AT and reduce the discontinuance rate.

Another recent study examined concerns about provider impact adoption of AT. Craddock and McCormack (2002) determined that having to travel long distances for services, being in unfamiliar testing situations, and taking time off from work were reasons provided for lack of AT services. The authors recommend moving from a medical model of rehabilitation to a social model, focusing on people with disabilities in their social settings. They also recommend establishing more stringent qualifications for service providers who make decisions on AT. To help alleviate the differences in opinions in services to be provided the authors suggested that a Certificate in Assistive Technology (CATA) for people with disabilities be implemented. The authors piloted the development of Technology Liaison Officers (TLO), who are people with disabilities themselves, to provide local AT support. The TLO provide guidance, training and follow up with the

people who are utilizing the AT for the first time in their environments. The authors indicate that since the implementation of the TLO program, AT retention has increased. Qualitative measures further indicated positive results.

Pape, Kim, and Weiner (2002) addressed the need for people with disabilities and clinicians to evaluate personal factors associated with selecting AT and how those factors affect the adoption of AT. They suggested that both the utility of a device and its impact on culturally defined social roles affect device selection and use. In other words, while a device or piece of equipment may be functional, it my not adequately mesh with the individual's cultural heritage or have the desired social outcomes. The authors also reported persons with acquired disabilities considered sense of control, level of independence afforded, mechanical or technical performance of the device, changes in the disabling condition or disability status, maintenance of preferred self image, functionality and timeliness, and the ability of the device to promote pleasurable or recreational activities. These authors further noted that factors impacting person with congenital disabilities might be markedly different since people born with disabilities have generally higher rates of AT use.

Summary

Although the literature search did not provide any citations particular to the adoption or discontinuance of communication technology with people who are deaf or hard of hearing, some insight into adoption, retention, and discontinuance may be gained. The impact of information, training, cost, availability, and design on adoption, retention, and discontinuance are notable, as is the clear trend toward consideration of quality of life and psychosocial impact factors in determining AT options for consumers. In fact, authors have noted that assistive technology device might actually hinder the individual's presentation of their preferred identity or self-image unless such concerns are taken into consideration before a device is prescribed or purchased (Hocking, 1999; King, 1999; Pape, Kim, and Weiner, 2002). This phenomenon may be especially critical in the deaf community, with its strong sense of cultural identification.

PIADS Related Literature

Authors and developers Hy Day and Jeffrey Jutai first tested the validity of the PIADS in a 1996 study with eyeglass and contact lens users (day & Jutai, 1996). Since then, various researchers on Dr. Jutai's team have undertaken validation and utility studies of the PIADS with a variety of populations. The relevance of the PIADS to

children has recently been studied, as has a translated French-Canadian version. Though the PIADS has never before been used with people who are Deaf and Hard of Hearing, the most in-depth clinical research using the PIADS has included persons who use communication aids.

Concerned with the PIADS ability to measure the stability of the impact of AT, Day, Jutai, Woolrich, and Strong (2001) conducted a study using the instrument with 175 eye clinic patients. Based on a literature review, the authors postulated that the psychosocial impact of an assistive device would decrease over time as the user became accustomed to its use. Participants completed the PIADS at baseline, two months later, and one year later. The research results indicated that the positive benefits associated with the AT did not decrease over time with the people who had chosen to continue using it, suggesting that novelty effects may be less related to AT usage that previously thought. Jutai, Day, Woolrich, and Strong (2003) conducted a follow-up study with a much larger sample- 418 participants. Results of the investigation indicated a nearly 70% correct prediction rate of retention. The instrument was noted to better predict discontinuation in men, while it seemed better able to predict retention in females.

Expanding PIADS research into new populations using differing types of AT, Jutai, Bayley, Teasell, and Hartley (in Craddock, McCormack, Reilly, & Knops, eds., 2003) assessed the utility and accuracy of the instrument for 450 persons who had first incidence strokes. Findings indicated that the PIADS was a reliable measure of assistive technology adoption among the sample. However, the authors noted that results would be interpreted cautiously since they did not control for the severity of the strokes suffered. Differences among stroke survivors can impact many different areas, including the type of AT needed and preferred. They further noted that greater stigma is attached to devices like walkers and wheelchairs than to hand-held canes, which may have also impacted results. Although conducted with a generally older population with acquired physical disability, this study may have implications for use of the PIADS with people who are Deaf or Hard of Hearing. The Deaf and Hard of Hearing are also a population who experiences widely varied levels of severity and differing levels of stigma associated with available AT.

Jutai and Gryfe (1998) sought to evaluate how AT used by persons with Amyotrophic Lateral Sclerosis (ALS, also known as Lou Gehrig's Disease) impacts their perceived quality of life, and used the PIADS data collection

instrument. The researchers were also interested in whether the PIADS would correlate with other patient data that was routinely collected in exam, and to determine if the PIADS could predict patterns of adoption and discontinuance. Fifty-five individuals participated in the study, all having ALS in various stages of progression. Participants reported using a variety of AT, including wheelchairs, and voice output communication technology. A unique feature of this study was that data was collected not only directly from participants, but also from participants who were assisted by caregivers in PIADS completion, and participants whose instruments were completed wholly by caregivers acting on their behalf. Results suggested that caregiver tend to overrate psychosocial impact. Also, researchers found that PIADS score were not correlated with any changes in the individual's health status.

Translation

Demers, Monette, Descent, Jutai, and Wolfson (2002) participated in the development and evaluation of a Canadian-French version of the PIADS. The preliminarily title of the instrument is F-PIADS. To develop the F-PIADS, the researchers employed a cross-cultural translation protocol suggested by Guillemin, Bombardier, and Beaton (1993) that includes original translations by a team of target language native speakers followed by reverse

translations back to the original instrument. After an experimental version was prepared, the instrument was sent to a committee comprised of one of the authors of the original PIADS and a translator. The final step in the translation process included a pre-test of the F-PIADS with four bilingual participants who were AT users. Following development of the F-PIADS, the evaluative study was carried out with 120 participants at research sites in Montreal and Quebec City. Overall, data analysis supported the F-PIADS as a valid instrument. However, some difficulties were noted, and may have important implications for ASL users should an ASL versions be developed. The problems included issues with work independence, and multiple meanings of words and phrases especially for the concepts of independence and usefulness.

Noticing that children who use AT often become life-long consumers of AT, Jutai and Bortolussi (2003) have begun development of a children's version of the PIADS. The researchers have thus far undertaken a series of semi-structured interviews and focus groups with boys and girls aged 12 to 17 and their parents or caregivers. The interviews and focus groups gathered information about how children and their parents/caregivers define quality of life, about how well the children understood the vocabulary and terms used in the PIADS, and whether such a measure

would be useful and desirable. In general, the researcher found good agreement between the psychosocial concerns and construct reported by adults and children. Additionally, they found that the psychosocial concerns reported are represented in PIADS, suggesting that the PIADS may be a viable instrument for use with children.

In the study most closely related to this study, Jutai and Sanders (in Craddock, McCormack, Reilly, & Knops, 2003) reported on psychosocial outcomes of hearing aids. Noting that hearing aid outcome research is the most active area of audiological research, the authors sought to evaluate the sensitivity of several device specific adoption measures in addition to the PIADS. They also explored the relationship between expectations prior to device use and post-use. Study results indicated that the more a person used his or her hearing aids, the more benefit they perceived from the device. Also, results suggested that a person needed to use their hearing aids for a minimum of one year before their pre-use expectations were fully met. Regarding the PIADS itself, findings indicated that the PIADS was as useful and valid as other measures designed specifically to evaluate adoption of hearing aids.

Summary

The PIADS instrument has been validated in a number of settings, with a variety of both people and technology. The

small but growing body of literature supports the use of the PIADS with deaf and Hard of Hearing individual. It has been used successfully with people who use assistive communication technologies, and with individuals with elementary to intermediate English reading and comprehension levels. The constructs it aims to measure appear reasonably stable cross-culturally as well.

Selected Features of Rogers' Theory of Diffusion

As mentioned in Chapter I Introduction, Rogers' (2003) theory of diffusion of innovations is a widely accepted theory that describes the processes people use in decisions to adopt, discontinue, or reject technologies. Rogers has defined adoption as the "decision to make full use of an innovation as the best course of action" (Rogers, 2003, p. 21). The author defines rejection simply as "a decision not to adopt an innovation" (Rogers, 2003, p. 21). But discontinuance of and innovation is a more complex occurrence.

Discontinuance as defined by Rogers (2003) is the decision to reject an innovation after having previously adopted it. He states discontinuance comes in two forms replacement and disenchantment. Replacement discontinuance occurs when new meet the needs of the adopters better than the current model. Disenchantment occurs when the innovation fails to meet the long-term expectations of the

adopters. A common reason for disenchantment discontinuance among later adopters is they tend to have fewer resources to provide the needed support to maintain the innovation and have less formal education than do the early adopters (Rogers, 2003).

Riemer-Reiss and Wacker (2000) suggest that selected features of Rogers' theory provides an overarching philosophical framework regarding the processes around accepting, using, abandoning, or fully rejecting technology, including assistive technology. It is important to note that the theory is not purported to be a model of outcomes in the current study, nor is it a construct under investigation in this study. Rather, Rogers' adoption categories are relevant to current research findings and serve as a conceptual structure for understanding and interpreting the results in this study. To that end, a discussion of Rogers' Decision Process (2003) is provided, followed by an exploration of Rogers' Adopter Categories and Characteristics (2003). Finally, an overview of Rogers' Perceived Innovation Attributes concludes this section of the literature review.

Innovation Decision Making Process

In some of the earliest related research, Ryan and Gross (1943) reported that diffusion of an innovation is a decision making process that includes informal

communication channels to provide initial information, more formal exploration of additional sources of information, an innovation trial period during which an innovation is used on a limited basis, and finally (and possibility several years later) adoption the innovation. Through the innovation decision process, a person makes a decision to adopt or reject an innovation, or to initiate or reject some change in activity related to the innovation (Prochaska, DiClemente, & Norcross, 1992; Rogers, 2003). Rogers (2003) encapsulated the decision process into five stages including the knowledge stage, the persuasion stage, a decision stage, the implementation stage, and lastly, the confirmation stage.

Knowledge Stage

Becoming knowledgeable of an innovation can be active or passive, according to Rogers (2003). A person may actively seek information about a new innovations or technologies, while another person may wait passively to be informed about innovations or technologies through other channels. There are three types of knowledge associated with innovation, which Rogers labeled Awareness, How To, and Principle knowledge (Rogers, 2003). Awareness knowledge happens when an individual is aware that an innovation exists and knows what the innovation is. For example, a person who knows that a video relay service exists and that

VRS is video system that allows Deaf people to communicate has Awareness knowledge of VRS. Taking awareness a step further, How To knowledge suggests that a person knows how to use or operate a particular innovation. Rogers (2003) noted that the amount of "how to knowledge" obtained before an actual trial of the innovation is correlated to the successful adoption of the innovation. Thus, a person who know VRS exists, understands what it is, and has been trained on how to use it (and may have in fact actually used it) would be a person with How To knowledge (Rogers, 2003). Lastly, Principle knowledge is the type of knowledge one has when one grasps the theory behind an innovation. Rogers (2003) has stated that the adoption of an innovation is positively correlated to its users having an understanding of the principles or theories behind the functioning of the innovation.

Persuasion Stage

In the persuasion stage, a person will decide what information and messages about the innovation are credible and how they will interpret them. A person might run imaginary trials of the innovation prior to actually physically engaging in the proposed innovation. They might also check with others who have similar opinions and beliefs to provide reinforcement that they are interpreting the risk and possible outcomes consistently with their

peers. Perceived positive outcomes are essential to progressing in the persuasion stage. Once perceptions of the positive aspects of the innovation are greater then the perceived possible negative aspects, the decision process moves into the decision phase (Rogers, 2003).

Decision Stage

The decision stage is the part of the decision process in which the new idea or innovation is tried on a limited basis. During the decision stage, three very basic decisions can occur, including adoption of the innovation, active rejection of the innovation, or passive rejection of the innovation. Active rejection occurs when legitimate thought and evaluation is provided towards making an informed decision to adopt or reject the innovation and the decision is to reject the innovation. Passive rejection is described as a situation in which the innovation was never taken seriously or considered as an option in the trial period. However, should the innovation be adopted, the innovation-decision process moves into the implementation stage (Rogers, 2003).

Implementation Stage

When an innovation is put into practice and actual behaviors start to change, the implementation stage is under way. A critical concern in the implementation stage is handling problems with the innovation that may arise.

So, it is in this stage technical support must be provided if an innovation is to be successfully adopted (Rogers, 2003). When an innovation is implemented and supported over a period of time, it becomes part of one's routine. Routinization happens when the innovation has become a part of one's day-to-day routine, marking the end of the innovation being experienced as something newly introduced to something that part of the norm (Rogers, 2003). For those who adopt the innovation this is the end of the decision stage.

However, there are some adopters who have a need to re-invent and fine tune the innovation to meet highly particular needs. For these adopters, the implementation stage continues through the re-invention process (Rogers, 2003). Re-invention occurs when a person wants the innovation to solve a wide range of problems and then looks for ways to make that happen. Re-invention may include simple cosmetic changes in the appearance of a device. Or reinvention may be more complex, such as complete repurposing of a tool or technology for some radically different purpose than it was originally intended for (Rogers, 2003).

Confirmation Stage

One might assume that after the reinventing was complete and the decision to adopt the innovation was done,

the innovation decision process would end. However, it has been noted that people sometimes continue to seek confirmation and reinforcement of their decision even after having fully adopted an innovation (Rogers, 1995, 2003) Individuals in the confirmation stage are often looking for information or group opinion that supports their adoption decision. If enough negative feedback is gathered, the individuals may change their mind and discontinue the use of the innovation. Conversely, if enough supportive feedback occurs the adopter is likely to try to promote the innovation to others in the social system (Rogers, 2003

Adopter Categories

To the current study, the categories of innovation adopters as described by Rogers (2003) are the most pertinent theoretical concepts. Rogers (2003) notes that adopter categories have been developed to describe the degree, in terms of time, in which a person or group will likely adopt an innovation. The five adopter categories are Innovators, Early Adopters, Early Majority, Late Majority, and Laggards and a discussion of each follows. Due to Roger's assumptions of a normal distributed population, the mean and standard deviations of the Bell frequency curve mark the five adopter categories, though the curve is asymmetrical with three adopter categories to the left of the mean and only two categories to the right. Although it

would be possible to remedy the imbalance by breaking the Laggard category into “early” and “late” sub-categories, Rogers (2003) holds that doing so is inappropriate due to the high homogeneity within the Laggard group.

Innovators

According to Rogers (2003) Innovators should represent approximately 2.5% of a population of adopters. Innovators can be seen as gatekeepers of innovations in that they are the people who often introduce an innovation into their environment, and are often more sophisticated and well informed than those around them, and sometimes their interest in new ideas or scholarship keep them out of certain social circles. They are usually daring people who enjoy the risky. Innovators can form cliques to communicate new ideas and information, and generally are eager to try and adopt innovations. They do not rely on outside influences to make a decision to adopt or reject an innovation, and may have more financial assets and so are better able to absorb losses if an innovation doesn’t work out.

Early Adopters

Early-adopters, who account for about 13.5% of the population, are usually more respected in the social system than Innovators, who are often seen as the outliers they are. Early Adopters seek to reduce any risks they may

perceive related to innovation adoption, but nonetheless can work to increase adoption rates. Often, early Adopters hold positions of official or unofficial authority and serve as group opinion leaders. Within organizations, management/administration may enlist people in this category to help influence the decision of others, including the following group- the Early Majority.

Early Majority

Comprising just over a third of the population, the Early Majority is one of the largest adopter categories. Persons in the early Majority are not likely to be in positions of leadership and take significantly more time than Innovators or early Adopters do in deciding whether to accept an innovation. Not highly interested or especially resistant to innovation, they are not first or last to adopt an innovation. Because of this, they form cohesion between the early adopters and the late majority.

Late Majority

Late majority Adopters also represents about a third of the total population. People who are Late Majority Adopters may be skeptical, and usually wait for all the risks associated with an innovation to be remedied before they will even try it. This group has relatively high resistance to innovations. They must observe people that are similar to them using the innovation successfully

before they will decide to adopt it, sometimes coming under significant social pressures before they accept an innovation. Late majority adopters generally have fewer financial resources to recover from costly or ineffective technologies and therefore tend to wait until either pressure is applied and/or they feel it is safe to adopt the innovation.

Laggards

The Laggard group comprises the last 16% of the population to adopt an innovation— if they ever adopt at all. Where the Innovators and Early Adopters split the first two standard deviations from the mean, the Laggards represent the last two standard deviations from the mean. In the most positive sense, Laggards may be seen as traditional; people who look into the past to predict the risk of new innovations. Laggards can require a much, much longer decision-making timeframe than any other group between the knowledge stage and far less influence with others in the social system than early adopters. They tend to communicate with others in the group and have a need to be certain that an innovation will not fail because of limited resources (Rogers, 2003).

Adopter Characteristics

The above descriptions of each group include some commentary on certain salient personality traits and

financial realities of each group. But Rogers' descriptions are much more than just anecdotal and supposition; Rogers (2003) has stated that longitudinal diffusion research has shown the characteristics of adopter categories can be generalized into three categories including socioeconomic characteristics, personality variables, and communication behavior.

Socioeconomic characteristics

Innovators and Early Adopters tend to have higher levels formal education, better-compensated employment, more opportunities for advancement in employment, and higher social status with the ability to socially climb. Conversely, people in Late Adopter categories usually have less formal education and lower status employment, such as blue-collar jobs. Consequently, Innovators and Early Adopters usually have more real assets than later adopters of innovations. Interestingly, Rogers has found no differences on age among early or late adopting groups.

Personality variables

Rogers has also noted differences in personality variables among adopter groups. Earlier adopters demonstrate greater empathy than later adopters. Earlier adopters may have more flexible, less rigid systems of personal beliefs—in short, they are more open minded. People in Innovator, Early Adopter, and Early Majority

groups tend to have a higher level of self-efficacy, score better on standard measures of intelligence, and exhibit more rational and abstract thinking capabilities. Also, people in early adopting groups usually have a positive outlook towards change in general and technology and science specifically than the individuals in late adopter categories.

Communication Behaviors

Different communication behaviors exist between early and late adopting groups. Earlier adopters exhibit higher levels of social participation than later adopters, and have greater access to and communication with persons in authority/decision makers. Generally, people in early adoption categories have more exposure to mass media communication then do people in late categories, and seek out information through personal and public communication channels (Rogers, 2003). People in later adopting groups tend to be less interested in social gatherings or in making social connections at work.

Perceived Innovation Attributes

Perceived attributes of the innovation have shown to be the predominant factors in determining if an innovation will be adopted or rejected by its intended users or rejected (Cooper & Zmud, 1990; Moore & Benbasat, 1991; Prescott & Conger, 1995; Rogers, 1995, 2003). Rogers (2003)

further states there are a variety of variables that affect the rate of adoption of innovations in social systems. The type of innovation, the communication channels, the nature of the social system and the amount and type of effort the change agent is exerting all affect the rate of adoption of proposed innovations. Most past research concentrated on predicting the rate of adoption by the five perceived attributes on innovations. He has collected several thousand innovation studies and identified five common attributes, and drawn generalizations from the attributes as they relate to adoption rates of innovations a) relative advantage, b) compatibility, c) complexity, d) trialability and e) observability. Rogers (2003) defined perceived innovation attributes as follows.

Relative Advantage and Compatibility

First, relative advantage is described as the degree to which an innovation is perceived as better than the innovation or idea it replaces. For example, as a faster mode of transportation, airplanes have had high relative advantage over ships. Compatibility, the second perceived attribute, refers to how consistent an innovation is perceived to be with the needs of potential users, their existing values, and their past experiences. Both relative advantage and compatibility are positively correlated with rate of adoption.

Complexity, Trialability, and Observability

The third attribute described by Rogers (2003) is complexity, which is negatively correlated with adoption rate. Complexity is the degree to which an innovation is seen as difficult to use and/or understand. The more difficult to use an innovation is thought to be, the less likely it is to be adopted. Conversely, the fourth attribute of Trialability is positively correlated to adoption. An innovation is considered Trialable if it can be experimented with on a limited basis. Test driving a car before purchasing it is a common example of trialability. The fifth and final perceived innovation attribute described by Rogers (2003) is termed observability. Observability is the degree to which the results of adopting an innovation are visible to others, and is also positively related to adoption of innovation.

Conclusion

Assistive technology is intended to assist people with disabilities in improving their quality of life, including self-efficacy, psychological well-being, personal control, and self-acceptance (Ryff & Singer, 1998). Over the years, AT has evolved and improved to better meet the needs of people with disabilities. Legislation has been passed mandating the provision of AT across a variety of settings. Though time is spent utilizing various models of AT

selection and resources are spent in securing AT for people with disabilities, much AT is not adopted, is abandoned, or simply rejected (Heinemann, Magiera-Planey, Schiro-Geist, & Grimes, 1987).

Past assumptions that responsibility for slow or reluctant adoption lies with consumers and/or providers rather than with flaws in the device have limited merit (Fellendorf, 1983). Rather, a broad range of medical, technical, social, and cultural factors come into play, with psychosocial considerations recently emerging as highly critical to successful AT adoption (Gitlin, Levine & Geiger, 1993; Phillips & Zhao, 1993). While some AT outcome measures have been developed, the literature has shown a continuing need for an instrument that considers psychosocial aspects of how AT effects the consumer and has predictive qualities for adoption of AT (Day & Jutai, 1996; Jutai & Gryfe, 1998). The PIADS has been determined to be a valid and reliable tool for measuring psychosocial impact of AT and for predicting AT adoption or discontinuance (Day & Jutai, 1996; Jutai & Gryfe, 1998; Day, Jutai, Woolrich, & Strong, 2001; Jutai, Bayley, Teasell, & Hartley, 2003)

METHODS CHAPTER III

This chapter presents the research methodology used in the study. First, the rationale for using a non-experimental research design is explained. Then, the participants, variables, and instruments are discussed. Next, data collection, statistical hypotheses, and research questions are addressed, and the data analysis procedures are described. Finally, the limitations of the study are described.

Research Design

This study employed a non-experimental research design. As Tabachnick and Fidell (2001) noted, in non-experimental research methodology the researcher does not have control of the assignment of the subjects to groups. A non-experimental approach does not allow for determination of causal relationships, however, the relationships of the criterion and predictor variables can be determined with some degree of confidence. Because the study will consider the relationships between two groups, predictor and the criterion variables, the non-experimental method is appropriate.

Participants

The sample for the study was drawn from the population of employees at the Texas School for the Deaf (TSD) (Texas State Classification Office, 2003). Personal interviews with each of five Department Heads at TSD identified 125

Deaf or Hard of Hearing target participants. The agency demographic information (Texas State Classification Office, 2003) is similar to the sample population for this study, therefore incidental sampling method can represent the larger population.

Of the estimated 125 potential participants, 115 people chose to participate in the study. No controls were set in place to identify and select any particular number of participants by gender, age, years of employment with TSD, however, these characteristics and demographics were measured. Of this group, the sample included residential staff, general staff, teachers and administrators who had been identified as having participated in TSD provided VRS training. The sampling method was incidental because even though each member of the sample was given the opportunity to participate, participation was ultimately voluntary.

Research participants self identified their hearing classification as either deaf, hard of hearing, or hearing. No auditory status documentation was requested to verify classification membership, since a key feature of being considered deaf or hard of Hearing is culturally identifying oneself as such. Although only responses from persons identifying themselves as either Deaf or hard of Hearing were included in the study and Hearing persons were not active sought out, participants were given the option to self identify as Hearing if they wished.

Informed Consent and Privacy Protections

This study was reviewed through the process of the University's Internal Review Board (IRB) and was determined to be exempt from full IRB review because all participants were adults and there were no risks or negative effects to participants in the study. All of the study participants were provided with a document entitled, "Informed Consent Summary", requested by the TSD Board during their review, prepared by the researcher and approved by the RCE Program Chair. The participants also received "Informed Consent to Participate in research", IRB # 2002-09-0095.

Variables

Level of Adoption is the criterion variable in this study, based on Rogers' (2003) theory on Adopter Categories. Four differing levels of adoption were possible: Early Adopters, Early Majority, Late majority, and Laggards. While Rogers' theory describes five Adopter Categories, the category of Innovator was deemed inappropriate, since all of the study participants had been introduced to VRS by TSD.

The participants were categorized into adopter groups based their responses to using VRS at work and home. The Early Adopters were those participants who utilize VRS at work and also have the system in their homes. Early Majority group members were those who have the system in their home but do not to use it at work, while Late

Majority adopters were those who use the system at work, but not in their homes. Lastly, the Laggards were determined to be those who do not use the system at work or at home.

Participants identified their membership in the predictor variable categories through responses on the instrument used in the study. There are several predictor variables in two broad categories, psychosocial and demographic. Three psychosocial predictor variables were included: Competence, Adaptability, and Self-esteem. These variables are further described in this chapter's section on research Instrument. Nine demographic predictor variables were used, including Communication Mode, Job Title, Past Phone Use, Years Employed, Hearing Level, Training, Gender, Age, and Education Level.

Instrument

Two survey questionnaires were used in this study, a demographic questionnaire developed by the researcher, and the Psychosocial Impact of Assistive Device Scale (PIADS). Survey questionnaires are valid data collection tools, because the responses can be generalized to other members of the population or other similar populations, and the surveys may be reused to compare responses to different groups times or places (Al-Gahtani, 2003; Newsted, Huff, & Munro, 1998).

Of the estimated 125 potential participants, 115 surveys were returned. Twelve of the responses were not considered in the study. Some of the responses were not signed, some were incomplete and a few were not employees of the Texas School for the Deaf. One hundred and three surveys were deemed useable for the study resulting in a strong response rate of approximately 82%.

Demographic Questionnaire

The demographic questionnaire was developed using Rogers (2003) Theory of Diffusion as the theoretical framework. The information collected on the demographic questionnaire included Hearing level (Deaf or Hard of Hearing); gender (Male or Female); primary mode of communication (Signing, Speech reading, Hearing, Total Communication, Other); levels of formal education (six categories from did not graduate from high school to holding graduate degrees); Job Title (will vary); and Total years employed with The Texas School for the Deaf (will vary).

Psychosocial Impact of Assistive Devices Scale

Day and Jutai (1996) designed the Psychosocial Impact of Assistive Devices Scale (PIADS). This is a 26 item self-reported assessment of the impact on independence, well-being and quality of life. Each item is rated from –3 to +3. The negative denotes a decrease in psychosocial functioning, zero is neutral and +3 indicates an increase

in psychosocial functioning. Jutai and Day (2002) report three subscales have been developed as a result of factor analyses in several studies. The subscales are (a) competence, (b) adaptability and (c) self-esteem. The competence subscale is reported to be sensitive to the impacts of assistive technology on performance and productivity. The second, adaptability, measures the amount a person is able to participate in other activities, take chances, and try new things as a result of the assistive device. The third subscale, self esteem, measures feelings of emotional health, happiness and the impact the assistive device has on self-confidence and well-being (Jutai & Day, 2002).

Jutai and Day (2002) report good psychometric properties of the PIADS. Using the Statistical Package for the Social Sciences. The PIADS was found to be homogeneous but not redundant. The interim correlations yielded a mean of 0.43 and variance of 0.01. The split half reliability test scored 0.89. Alpha reliability for the three factors were as follows: competence = 0.923, adaptability = 0.878, and self-esteem = 0.869.

To check to see if the participants were not telling the truth on the instrument, the PIADS was correlated with the Eysenck's Lie Scale. The correlation was negative, indicating the participants were not providing false

answers to create a positive image on the PIADS (Day, Jutai, & Campbell, 2002).

Test-retest (six month span) reliability scores ranged from .77 to .85. Principle component analysis was used to evaluate construct validity of the scale. A study of 307 eyewear device users showed the three subscales accounted for 61.1% of the total variance. Similar results were obtained when the instrument was used for other assistive technologies such as contact lenses and wheelchairs (Jutai & Day, 2002; Demers, Monette, Descent, Jutai, & Wolfson, 2002; Jutai, Rigby, Ryan & Stickel, 2000).

Jutai and Day's (2002) study shows that PIADS is sensitive to the psychosocial impact of assistive technology across a broad population of AT users and seems able to predict the likelihood of AT adoption. PIADS authors also noted that a predictable pattern of psychosocial response could be seen related to stigma attached to the assistive technology (Jutai, 1999).

Data Collection

As previously mentioned, the researcher met first with all five TSD department heads, followed by meetings with small groups of supervisors at the Texas School for the Deaf (TSD). An explanation of the research was provided and volunteer participation was solicited. The supervisors identified employees who had received VRS training in the Fall of 2003 via the TSD Research Liaison. The supervisors

attended a training provided by the researcher to explain the research and completion of the forms. Each supervisor received additional forms, which they distributed in staff meetings for participant for perusal and signature. Participants were made aware that they could discontinue participation at any time and that any identifying information obtained in connection with the study would remain strictly confidential. A copy of the informed consent document is provided in Appendix A.

Initially, using the chain of command strategy as described above, the return rate of the surveys was insufficient to conduct statistical analysis. Many of the responses that were received were not completed or signed. It became evident that the chain of command method of data collection needed revision.

Permission was sought and granted to meet with potential participants during their break and lunch times as well as in the dorms in the evenings for those employees who do not have allowed breaks during their shifts. Each potential participant met with the researcher on an individual basis and was provided an explanation of the process and the forms including a summary of the consent requirements and research project, the University of Texas at Austin IRB consent forms, the demographic survey, and the Psychosocial Impact of Assistive Device Scale (PIADS) with the approved synonym sheet for the PIADS copied on the

back. A six-week window of opportunity was provided to return the completed forms. Upon completion, the participants returned the completed forms to the TSD Research Liaison or the researcher. Using the revised data collection process, the useable response rate was 103 out of the estimated possible 125, or approximately 82%.

Null Hypothesis

Recapping from Chapter I, the null hypothesis was stated as, "Psychosocial and demographic variables will not predict among four levels of adoption of video relay services. More technically, the null hypothesis may be stated as, "Linear combinations of psychosocial and demographic variables will not discriminate among four levels of adoption of VRS assistive technology."

Data Analyses

Multiple Discriminate Analysis (MDA) is the statistical technique appropriate for testing the hypothesis. This system was selected due to the large number of factors in the continuous and discrete predictor variables and the four categories of adoption in the criterion variable in the study (Tabachnick & Fidell, 2001). Ideally, orthogonality would exist amongst all of the variables. However considering the large number of factors, two or more may be highly correlated ($R>.90$) and therefore be considered covariates. A factor analysis was run to determine covariation.

With regard to the predictor variables, it is assumed that all the scores for each of the predictor variables are random and normally distributed. However, there are no tests for this. In order to overcome the suspicion of non-normality, sample size is increased. Tabachnick and Fidell (2001) recommend a minimum of 20 cases in the smallest group when there are only five predictor variables. In this study there are 12 possible predictor variables, N of 100 will suffice in keeping the results effective.

Cleaning Data

Transferring large amounts of data from a hard copy to a computer operated statistical program can be problematic Tabachnick and Fidell (2001). In an attempt to limit human error, two different people checked the raw data for accuracy. After accuracy was verified, frequencies were run to insure that the values fell within expected ranges and no cases had missing data.

Outliers can be hazardous to the validity of the results of any study and need to be identified. Tests for univariate and multivariate outliers were run separately. To find outliers and minimize their effects, Mahalanobis distance and standard *z* scores were used to find the distance a case is from the centroid of the remaining cases in the study measured in x^2. A conservative value for this distance is $p<.001$ and considered acceptable. With regard

to the z scores, any value larger than 3.29 or smaller than –3.29 are considered outliers. MDA is sensitive to outliers (Tabachnick & Fidell, 2001).

Limitations of the Study

As stated in Methods chapter, every research project is subject to numerous limitations. Though efforts were made to minimize limitations, this project was subject to several potentially limiting factors. First, the statistical method itself imposes several limitations, including shrinkage. Additionally, the participation of individuals for whom English is not their native language and resultant English literacy concerns could have impacted survey results. Further, the study may have been vulnerable to novelty effects and pro-innovation bias associated with the introduction of an innovation. Lastly, the results may not generalize to other populations, settings, or communication technologies.

Methodological Limitations

When considering using data from a Multiple Discrimant Analysis to assist in the decision process of expending funds for any AT, careful consideration needs to be given to the Prediction matrix of the results. Low prediction Matrix scores indicate that the members of the groups were not classified correctly. If left unnoticed, this error can mislead people utilizing the data by providing inaccurate counts in groups (Tabachnick & Fidell, 2001). Replication

of the study may also be problematic. Inevitable error in the data, due to method of collection and solicitation of responses, will be unique in each study using the MDA. With each attempt to replicate the findings, shrinkage of prediction accuracy will occur. The predictive abilities may be weakened with each attempt (Tabachnick & Fidell, 2001).

Participant Literacy Level

It is documented in the literature that reading levels can be problematic for individuals who are Deaf and Hard of Hearing. There were two potential participants who refused to participate for this reason. Therefore, they were not part of the study. However, an unknown number of individuals with similar concerns may have participated despite not being fully literate of the terms used on either instrument. To reduce the problems associated with reading the questionnaire, a glossary of terms was included with the forms. Each person who received the forms, regardless of title or education level, was shown the glossary and asked if they needed clarification of any of the terms. Staff interpreters were also available at the request of the participants.

Novelty Effect and Pro-innovation Bias

The novelty effect refers to the positive results created by an innovation simply because it is new (Mertens, 1998). Because the VRS has only been available for the

participants at TSD for a year, and many had no prior knowledge of the innovation, their experiences and perceptions may have been influenced by the novelty effect. The possibility of the novelty effect was not introduced to the participants in the participant solicitation process. Longitudinal studies may be needed to further address any possible limitations created by the novelty effect.

Pro-innovation bias occurs when the researcher or investigator feels strongly that the innovation being studied should be diffused into the social system and adopted by all of the people in the population without hesitation or reinvention or rejection. This circumstance can occur when the researchers have a vested interest in the adoption of the innovation (Rogers, 2003). While the primary investigator in this study has been exposed to Video Relay at the Texas School for the Deaf, in the form of a demonstration of the technology, implementing the technology in the home and office has been intentionally avoided in an attempt to minimize this bias. Additionally, as grant fund recipients for VRS, TSD has vested interests in the success of VRS with its employees. The institution's interest could have potentially influenced participation in this study, though no participants noted any institutional pressures to participate.

Generalizability

Finally, generalizability may also be an issue for this study. Employees of TSD may not be representative of Deaf and Hard of Hearing adults throughout the U.S. Though efforts were made to locate data related to the characteristics of employees of Schools for the Deaf nationwide, only data from Texas and Louisiana were available. Given the paucity of available information, report from Texas and Louisiana are not reported herein. In addition to concerns related to the sample of the study, it is critical to note studies conducted with other types of communication technologies may produce radically different outcomes. VRS is but one a many communication technologies, and its unique features may have resulted in highly unique findings. Additionally, the setting of this study was very specific, so results gathered may not apply in other settings, although individual participants might also be Deaf and Hard of Hearing. Schools for the Deaf each have their own organizational identity and educational philosophy. Accordingly, it can be assumed that differing levels of interest in and support of communication technologies such as VRS exist.

Importance of Results

There are several specific reasons the results of this research are beneficial to the fields of Vocational Rehabilitation and Special Education. From an

administrative standpoint, the mandate to provide reasonable accommodations and balance limited budgets can be difficult. The administration of direct service institutions may be able to use the PIADS scores and demographic information of the staff to approximate how many individuals may utilize an accommodation. The results from this study could also assist the administration with determining if adoption of VRS as their primary mode of communication for its employees who use manual communication needing to make phone calls as an essential job duty is prudent. It may also help facilitate the development of plans and policy to assure adequate equipment and staff is available to optimize the use of VRS. This research may lead to further studies of Rogers' (2003) theory to help expedite adoption of the innovation and to foster better communication.

More generally for the field of Vocational Rehabilitation and Special Education, this research should add to the body of knowledge regarding adoption of AT, especially the adoption of communication technologies, which have not been study in depth as of yet. The findings may also help confirm the veracity of the psychosocial factors and sub scales of the PIADS in discriminating to adopter categories, thus enabling more efficient and meaningful AT acquisition.

Summary

This research was conducted at the University of Texas at Austin in the Department of Special Education Rehabilitation Counselor Education graduate program. One hundred and fifteen adult employees of the Texas School for the Deaf participated. One hundred and three participant surveys were useable and analyzed. Of the useable forms, 44 were in the Early Adopter category, 7 in the Early Majority, 31 in the Late Majority and 21 were in the Laggard category.

The project examined psychosocial and demographic variables that, in linear combinations, have the potential to discriminate among four levels of adoption of VRS. A non-experimental research design was selected based on the nature of the research questions and the context being studied. A demographic survey and the Psychosocial Impact of Assistive Devices Scale were used to collect data. Multiple Discriminant Analysis was used to analyze data and research credibility was addressed through the use of multiple person data checking and frequency checks. Researcher and participant bias, novelty effect, and pro-innovation bias were also noted as possible limitations of this study.

RESULTS CHAPTER IV

This study produced a wealth of information regarding the psychosocial and demographic variables, which discriminate between adopter categories of Deaf and Hard of Hearing Adults with regards to the use of Video Relay Services (VRS). Although participants were identified though one source, The Texas School for the Deaf, and participation in the study was on a voluntary basis, all of the variables approached normality as the Rogers' Adoption theory would suggest. The following, in both narrative and tabular format, is a summary of the data obtained and the results of the statistical analyses conducted.

Characteristics of the Sample

There were approximately 125 potential participants. One hundred and fifteen forms were returned. Of those, there were 12, which were deemed unusable because the forms were not fully completed, lacked signatures or they were not employed by TSD at the time of the study. One hundred and three were useable resulting in a response rate of approximately 82% of the total number of potential responses. A range of employment of the first year through 25 years was presenting the sample. The mean years of employment was 7.4 years and the median was 4.0 years. A general list of response patterns on each variable selected for analysis is provided in Table 1.

Table 1

Frequencies and Percentages of Characteristics of Texas School for the Deaf Participants

Variable	Frequency	Percentage
Hearing:		
Deaf	75	72.8%
HoH[a]	28	27.2%
Gender:		
Female	56	54.4%
Male	47	45.6%
Communication:		
Manual	87	84.5%
Oral	16	15.5%
Education Level[b]:		
= or +	55	53.4%
>	48	46.6%
VRS[c] training:		
No	57	55.3%
Yes	46	44.7%
Past Phone Use:		
Electronic[d]	89	86.4%
Verbal	14	13.6%
Adopter Category[e]		
Early Adopter	44	42.7%
Early Majority	7	6.8%
Late Majority	31	30.1%
Laggards	21	20.4%

Table 1 (continued).

Frequencies and Percentages of Characteristics of Texas School for the Deaf Participants

Job Categories	Frequencies	Percentage
RLS[f]	47	45.6%
Teachers	24	23.3%
Aids	15	14.6%
Supervisors	8	7.8%
Counselors	3	2.9%
Trans & Main[g].	3	2.9%
Tech. Support	2	1.9%
Outreach	1	1.0%

Note. N = 103"
[A]HOH is "Hard of Hearing". [B]Education Level, equal to or more than a Bachelor degree and less than an Bachelor degree. [c]VRS is Video Relay Services [d]Electronic, includes email, TDD/TTY, Text messaging. [e]Adopter Category based on Rogers' (2003) Theory. [f]RLS is Residential Life Staff. [G]Transporation and Maintenance

The majority of the respondents were Residential Life employees 47 (45.6%), followed by teachers 24 (23.3%), then teaching assistants 15 (14.6%). There were 8 supervisors (7.8%). There were 3 each of transportation, maintenance personnel and counselors for 2.9%, each. The technical support area had two representatives two (1.9%) and one outreach specialist (1.0) was a part of this sample.

Of the 103 participants included in the analysis, 75 (72.8%) listed themselves as Deaf and 28 (27.2%) considered

themselves Hard of Hearing. There were nine more females than males represented, 56 (54.4%) and 47 (45.6%) respectively. The mode of communication preferred by the sample was the manual method 87 (84.5%), with 16 (15.5%) preferring the oral method. The educational level variables were close in the sample, 48 (46.6%) with less than a bachelors degree and 55 (53.4%) reported having a bachelors degree or higher. Training variable was similar in representation, 46 (44.7%) received training in the VRS system while 57 (55.3%) reported not having been trained. When asked what was their preferred method of using a phone system in the past, 14 (13.6%) preferred using an oral method, either using a regular phone or having another person make the call. The majority, 89 (86.4%) preferred a text base system such as TTY/TDD or Email.

Most of the participants report using VRS on the job, 75 (72.8%). The reasons for using it varied from making personal calls to business related calls such as contacting parents of the students. The number of people who report they use VRS at home was 52 (50.5%).

The distribution of participants in the individual factors of the criterion variable, (a) Early Adopters, (b) Early Majority, (c) Late Majority, and (d) Laggards (Rogers, 2003) was as follows (see table 2)

Table 2

Adopter Category Percentage compared to Normal Distribution

Category	Percent[a]	Normal[b]
Innovators	0.0	2.5
Early Adopters	42.7	13.5
Early Majority	6.8	34
Late Majority	30.1	34
Laggards	20.4	16.0
Total	100.0	100.0

Note: N = 103
a. Percent of the population in this study
b. Percent of a Normal distribution Curve

These results show the Late Majority and Laggard categories are fairly closely aligned with the Rogers' (2003) theory for distribution of Adopters. Divided into two groups, those who use VRS in their homes and those who do not, the distribution is close to normal. The Early Adopters and Early Majority represent 49.5% of the sample while the normal distribution would expect 50% of the sample in these two categories. Like wise with the Late majority and Laggards. They represent 50.5% of the distribution as compared to 50% of the Rogers' (2003) theory distribution.

Test of the Null Hypothesis

The null hypothesis was tested using a Multiple Discriminant Analysis (MDA) using the Statistical Package of the Social Sciences (Norusis, 2000). Frequencies were checked to make sure all of the data fell within expected ranges. Then using MDA, the variable, Adopter Category, was placed as the criterion variable and the discriminating variables were, (a) Hearing Level, (b) Gender, (c) Communication Mode, (d) Education Level, (e) Years Employed, (f) Training, (g) Past Phone Use, (h) Competence, (i) Adaptability, (j) Self-Esteem, (k) Title, and (l) Age. The Analysis Case Processing Summary verified the data set was complete.

Having verified completion of the data set, Wilks' lambda was checked to determine the level of importance of the predictor variables in differentiating among levels of the criterion variable, Adopter Category. The results of the MDA revealed three discriminant functions, one less than the number of groups in the criterion variable. Wilks' lambda was significant ($p < .05$) for the following variables: (a) Hearing Level, (b) Communication Mode, (c) Past Phone Use, (d) Competence, (e) Adaptability, (f) Self-Esteem and (g) Job Title. The significant finding indicates that the discriminating variables significantly discriminate among the four levels of the criterion variable. The eigenvalues, which report the percentage of

variance of linear combinations of predictor variables have on the criterion variable, can be assumed to be reliable. These linear combinations of predictor variables are known as the discriminant functions (see Table 3).

Table 3

Eigenvalues, Percent Variance, and Canonical Correlations for Three Discriminant Functions

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.331[a]	72.8	72.8	.756*
2	.391[a]	21.4	94.2	.530*
3	.106[a]	5.8	100	.309

a. First 3 canonical discriminant functions were used in the analysis.
*r > .50

As shown in Table 3, three discriminant functions were extracted. Function 1 shows a canonical correlation of .756, accounting for 72.8% of the variance. Function 2 shows a canonical correlation of .530, accounting for 21.4% of the variance. Function 3 was not statistically significant. It's canonical correlation of .309 only accounted for 5.8% of the variance. A significance test of the three discriminant functions (see Table 4), shows the

first two discriminant functions were statistically significant while the third was not significant.

Table 4

Significance Test for the Three Discriminant Functions

Test of Functions(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.279	120.076	36	.000*
2	.650	40.513	22	.009*
3	.904	9.460	10	.489

*p < .05

In order to determine the linear combinations of predictor variables, which make up the percent variance of the two discriminant functions, the standardized Canonical Discriminant Function Coefficients were reviewed (see Table 5).

Table 5

Standardized Canonical Discriminant Function Weights for First Two Discriminant Functions

	Discriminant Function	
Variable	1	2
Hearing Level	-.311	.091
Gender	-.117	.084
Comm. Mode	-.293	**-.552**
Ed. Level	.338	.180
Years employed	-.038	**-.492**
Training	.153	**.374**
Past Phone Use	-.189	.202
Competence	**.819**	-.039
Adaptability	.312	-.051
Self-Esteem	-.110	-.178
Title	.107	**.481**
Age	-.076	.112

Table 5 shows the relative importance of the predictor variables to the criterion variable (in terms of absolute values). The higher the absolute value the greater the importance of the variable in the discriminant function. The results displayed in Table 6 can also be used to assign labels to the discriminant function. Discriminant Function 1 showed 72.8 % of the total variance was comprised of the

predictor variables (a) Competence, (b) Adaptability, and (c) Self-Esteem.

Table 6

Structure Matrix: Correlations Between Discriminant Variables and Standardized Canonical Discriminant Functions

	Discriminant Function	
Variable	1	2
Competence	**.816***	-.362
Adaptability	**.755***	-.373
Self-Esteem	**.636***	-.252
Communication Mode	-.222	**-.550***
Title	-.031	**.461***
Past Phone Use	.146	**.453***
Years employed	-.128	**-.363***
Hearing Level	-.246	**-.356***
Training	-.077	**.340***
Gender	.055	-.046
Age	-.046	-.041
Education Level	.193	.223

Note: Pooled with-in groups correlations between discrimination variables and standardized canonical discriminant functions. Variables ordered by absolute size of correlation within function.
*. Largest absolute correlation between each variable and any discriminant function.
*P > .50

Since these variables are the psychosocial factors measured by the PIADS, Discriminant Function 1 was labeled

"Psychosocial Impact." Discriminant Function 2, comprising 21.4% of the total variance, loaded highly on the following predictor variables: (a) Communication Mode, (b) Title, (c) Past Phone Use, (d) Years Employed, (e) Hearing Level, and (f) Training. For simplicity, Discriminant Function 2 was labeled "Communication Mode" because this was the variable with the highest loading in the Structure Matrix. These results show that predictor variables (a) Age, (b) Gender, and (c) Education Level do not predict membership in the criterion variable.

In attempts to ascertain the usefulness of the analysis, it can be argued that the more cases are classified correctly, the better the chances of having useful results. Table 7 shows the percentage of cases classified correctly by the factors of the criterion variable Adopter Category. The individual factors of Adopter Category are (a) Early Adopters, (b) Early Majority, (c) Late Majority, and (d) Laggards. This result indicates 68.9% of the original grouped cases were correctly classified. The Early Adopter and Laggard groups were very well classified, 81.8% and 76.2% respectively.

Table 7

Percentage Predicted Group Membership in Four Adopter Categories

		Percentage classification for Four Groups			
	Groups	1	2	3	4
1.	Early Adopters	**81.8**	4.5	9.1	4.5
2.	Early Majority	71.4	**14.3**	.0	14.3
3.	Late Majority	32.3	.0	**58.1**	9.7
4.	Laggards	9.5	.0	14.3	**76.2**

68.9% of original group correctly classified. Numbers in bold are accurate classifications.

The overall predicted group membership score was lowered by the Early Majority and Late Majority. Their scores were groups, 14.3% and 58,1%, respectively. The low predicted score for Early Majority may be in part due to the small N. This is an unusual group because it has participants who use the VRS system at home but not at work.

With good predicted group membership scores the findings of the discriminate functions are assumed accurate. Function 1, “Psychosocial Impact” accounted for 72.8% of the variance, its components are significantly related to the criterion variable, Adopter Category,

therefore it can be stated that the psychosocial variables measured by the PIADS, (a) Competence, (b) Adaptability, and (c) Self-Esteem can determine group membership with moderate accuracy. Also, Function 2, "Communication Mode", accounting for 21.4% of the variance and with significant relationship with the criterion variable, can also determine group membership to a lesser degree.

In light of the results of this analysis, it was determined that linear combinations of psychosocial variables are able to discriminate among four adopter categories and the same was found for the demographic variables. Therefore, these findings lead to a rejection of the null hypothesis.

Additional Findings

In addition to finding linear combinations of variables which discriminate group membership, there were differences in the psychosocial variable mean scores of the Adopter Category groups (a) Early Adopters, (b) Early Majority, (c) Late Majority, and (d) Laggards (see Table 8). The mean score for each psychosocial variable decreases from Early Adopters to Laggards. The mean scores on all three psychosocial variables are in descending order. The order from highest mean score to lowest is Early Adopter, Early majority, Late Majority and Laggards.

Table 8

Psychosocial Variable Mean Scores by Adopter Category

	Adopter Category			
Variable	Early Adopters	Early majority	Late Majority	Laggards
Competence	2.36	2.12	1.91	0.41
Adaptability	2.47	2.05	2.01	0.52
Self-Esteem	2.04	1.86	1.65	0.46

Pearson's Chi-Square and Correlation were calculated to determine relationships among the demographic variables and psychosocial variables. Training was the only demographic variable to shown a statistically significant relationship with Competence and Adaptability *r(3) = -.248* (*p*. significant at .05) *and -.271* (*p*. significant at .01). However, Training did not show a significant relationship with the variable Self-Esteem.

Summary of Findings

The preceding statistical analyses have shown significant relationships among psychosocial variables, demographic variables and level of adoption of Video Relay Services (VRS). The findings show through Multiple Discriminant Function Analysis that the participants' scores on the psychosocial variables, (a) Competence, (b)

Adaptability and (c) Self-Esteem, of the PIADS can discriminate adopter group membership of adults who are Deaf or Hard of Hearing. The higher the scores on all three psychosocial variables, the more likely they are to adopt, as evident in Table 8.

In addition to the psychosocial variables, linear combinations of demographic variables were found to discriminate Adopter Categories. Four of the original nine demographic variables, (a) Hearing Level, (b) Communication Mode, (c) Past Phone Use and (d) Title, were found to significantly discriminate among adopter categories. A review of the relationships among the demographic predictors variables and the psychosocial variables showed Training was the only variable which had a significant relationship with the psychosocial variables. Training showed a significant relationship with the variables Competence and Adaptability, but not Self-Esteem. The participants who had VRS training, were more likely to adopt the VRS services than those who did not.

DISCUSSION CHAPTER V

This chapter primarily discusses the research findings in relation to selected features of Rogers' diffusion of innovation theory (2003) and provides a conclusion to the research. First, results related to Adopter Categories and Adopter Characteristics are examined (Rogers, 2003). Next, a discussion of the results as related to Perceived Innovation Attributes (Rogers, 2003). Finally, the implications for practice and policy are discussed, the contributions to the field are described, and recommendations for future research are detailed. A summary concludes the chapter.

Findings Related to Rogers' Theory

Rogers' (2003) theory of diffusion of innovations is a widely accepted theory that describes the processes people use in decisions to adopt, discontinue, or reject technologies. Rogers has offered definitions of the terms adoption, rejection, and discontinuance that are used across many fields of study and practice and have been used through the current study. It has been suggested that selected features of Rogers' theory provide a broad framework for studying the processes around accepting, using, abandoning, or fully rejecting assistive technology (Riemer-Reiss & Wacker, 2000). However, Rogers' theory was not the construct under investigation in this study, nor is a specific model of outcomes in the current study. Rather,

Rogers' adoption categories, adopter characteristics, and perceived innovation attributes are relevant here as a conceptual structure for understanding and interpreting the study results. To that end, a discussion of results related to Rogers' Adopter Categories and Characteristics (2003) follows. Consideration of Rogers' Perceived Innovation Attributes as related to the study results (2003) concludes this section.

Adopter Categories

When considering assistive technology outcomes, it has been recognized that outcomes exist on a continuum. People may rapidly or reluctantly accept new technology; they may resist adopting the technology or exhibit complete disinterest and never adopt. Sometimes, a technological innovation is accepted, only to be discontinued later (Rogers, 2003). Using Rogers Adopter Categories and Adopter Characteristics to describe the variety of AT adoption outcomes, the current study referenced four of five Adopter categories as described by Rogers (2003): Early Adopters, Early Majority, Late Majority, and Laggards. Further discussion of the results as related to these adopter categories follows.

Early Adopters

Rogers (2003) stated that Early Adopters are models for successful adoption of new technology among their peers. Early adopters often hold positions of authority and

serve as group opinion leaders. Rogers (2003) hypothesizes that adopter groups span the normal distribution, and that the Early Adopters would represent approximately 13.5% of the population. In this study, the Early Adopters, those who have stated they use VRS both at home and at work, represent 42.7% of the population. The larger than expected percentage of Early Adopters leads one to conclude that a significant group of Deaf and Hard of Hearing people may adopt new communication technology faster than the general public.

Considering the severe negative consequence of communication barriers between people who are Deaf and Hard of Hearing and the Hearing world, accommodations—in the form of assistive technology—to improve communication between people who are Deaf and those who hear. It is possible that the Deaf/Hard of Hearing community's keen interest in communication technologies result in earlier acceptance of innovation.

The early adoption phenomenon noted in this study may be in part due to the nature of the participants and environment where the study took place. Deaf and Hard of Hearing individuals may be more apt to move into the Early Adopter category than what would be expected following Rogers' (2003) theory because of the need to communicate with a various people in a variety of settings. The quick

decision to be in the Early Adopter category has had and effect on the Early Majority group.

Early Majority

Comprising just over a third of the population (34%), the Early Majority group is one of the largest adopter categories in this sample. Though willing to adopt new technology, persons in the Early Majority are less likely to be in positions of leadership and are more likely to take more time than Early Adopters do in deciding whether to accept an innovation. As Rogers (2003) hypothesizes, the Early Majority group in a normal distribution would represent approximately 34% of the population. However, in this study, the Early Majority, those who use VRS at home but not at work, represented only 6.8% of the sample. Such a finding may suggest that people who are Deaf and Hard of Hearing look more to authority figures and opinion leaders within their community for models of VRS adoption than to peers.

Late Majority

Though the Early Adopters and Early Majority departed somewhat from the literature as related to adoption of innovations, findings for the Late Majority and the Laggards follow the literature more closely. According to Rogers (2003) People in the Late Majority group are often skeptics, and usually wait for all the risks associated with an innovation to be remedied before accepting it. Late

Majority adopters have some strong resistance to new technologies. Furthermore, Rogers (2003) indicates Late Majority group members, like early Majority members, comprise about a third (34%) of the total population. In this study, the Late Majority represented 30.1% of the total population, suggesting that Deaf and Hard of Hearing Late adopters may have similar concerns to those of Late Adopters in other populations. Some of these concerns may be linked to specific adopter characteristics, which are discussed further in a following section on socioeconomic characteristics.

Laggards

Speaking positively, Laggards may be seen as traditional people who prefer to remain closely tied to the past, requiring a much longer decision-making timeframe than other groups. Laggards generally need to be certain that an innovation will not fail before accepting it (Rogers, 2003). On a normal curve, the Laggard group is expected to comprise the last 16% people who adopt an innovation, if they ever adopt it at all. In this study, the Laggards, defined as those who do not use VRS at work and do not use it at home, represented 20.4% of the population. Based on this finding, it may be speculated that Deaf and Hard of Hearing people, like others, may be reluctant to adopt new technology. Findings suggest that an organization interested in increasing VRS use might wish to

specifically address the concerns of employers expressing or exhibiting resistance to the technology, perhaps through increased opportunities to benefit from the device.

Rogers (2003) has stated that longitudinal diffusion research has shown that characteristics of adopter categories can be generalized into three categories including socioeconomic characteristics, personality variables, and communication behavior. In addition to the four Adopter Categories discussed above, the current research also considered specific adopter category characteristics. Of these specific categorical characteristics, the demographic findings related to socioeconomic characteristics seem most critical and interesting. Findings discussed include Age, Gender, Education Level, Years Employed, Job Title, and Communication Mode.

Adopter Characteristics

Rogers' (2003) theory of diffusion has stated that age and gender are not related to level of adoption. Consistent with Rogers' (2003) theory, the results of the current research demonstrated that age (r = .030, p > .05) and gender (r = -.012, p > .05) were also not correlated with Adopter category.

Education Level

Education Level also correlated with level of adoption (r = -.249, p > .05) as anticipated based on Roger's

theory. The theory of diffusion stated education level tends to correlate highly with early level of adoption – the more formal education a person has, the more likely they are to fall into the early adopter category (Rogers, 2003). In this study, approximately 68% of the Early Adopters held a bachelor's degree or higher, while about 32% had less than a bachelor's degree. Looking at the Laggards, approximately 57% had less than a bachelor's degree, while 43% held a bachelor's degree or higher.

The current study results are generally consistent with Rogers' specific adopter characteristics related to education levels. To confirm the results further, one could collapse both Early Adopters and Early Majority into one broad "Early" group, and Late Majority and Laggards into a broad "Late" group. Doing so, the Early group shows approximately 67% of the population holding a bachelor's degree or higher, while 33% do not. Of the Late group, the reverse is true. Approximately 60% have less than a bachelor's degree, while approximately 40% hold a bachelor's degree. These results further support Rogers' theory. The results may suggest that an organization interested in promoting VRS use across all levels of employees might need to target people with lower levels of education and provide them with additional incentive and support for device use.

Job Title

Reviewing additional factors of Years Employed and Job Title, it is not surprising to find that these variables correlated with each other. For purposes of discussion, consider that common wisdom suggests that people who have been employed with an organization for longer periods of time have enjoyed some upward mobility, and that Job Title can be an indicator of hierarchical job/social status. In this study, the types of jobs titles requiring more education, offering higher pay, and ranking higher on the chain of command may be termed Higher Status. Likewise, job titles requiring less education, offering lower pay, and ranking lower on the chain of command can be termed Lower Status.

Based on these assumptions related to Job Title, the Job Title results for the Early Adopters were split evenly at 50% each. In other words, an equal number of early adopters had high status and low status jobs, a result not consistent with the theory of diffusion of innovations, which states that the Early Adopters tend to have more education and rank higher in the chain of command (Rogers, 2003). When the results of the Early Majority are added to the comparison, the results further contradict the findings in the literature. The Higher Status of the Early group represented approximately 47% while the Lower Status represented approximately 53%.

The even results for higher-status and lower-status-titles among Early Adopters can be viewed as a positive. Rogers (2003) noted that most innovations are intended to benefit all members of a social system; however, as new innovations are released, the majority of the people benefiting from them are those in the higher socioeconomic status, as well as those who have more resources and are able to take more risk. This study reports information to the contrary, perhaps due to the high levels of motivation to use communication technologies among deaf and Hard of Hearing people. In the Early Adopter category, there are equal numbers of people with in positions requiring higher and lower levels of education. However, these results may be in large due to the number of people who received the equipment free of charge. However, at home users may still be responsible for the monthly cost of a high-speed DSL line, suggesting that at least some individuals in lower-paying positions are willing to invest personal resources to make use of VRS technology. This finding might support agency/employer use of financial incentives to ease the financial burden of VRS adoption on lower-paid persons, and may also suggest a need for governmental grants for the same.

On the other hand, the Laggards do follow the constructs of Rogers' (2003) theory on adoption and job status. The results of the study demonstrated that that

about 86% of the Laggards hold lower status jobs, while only about 14% reported higher status positions. As done with the Early Adopters and Early Majority Adopters, the Late Majority and Laggards groups were combined into a broad Late Adoption category to compare the differences among the higher and lower status categories. Results were not as dramatic as when using the Laggards alone in the equation; however, there was a definite distinction between the groups. The broad Late Adoption group with the higher status titles represented approximately 27% of the total, while the lower status title group represented approximately 73% of the population. This result is compatible with the literature, which indicates that the Laggards and Late Adopters are more likely to be in the lower status positions within an organization or population. In this study with Deaf and Hard of Hearing employees, it may be noted that Late Adopters were generally the Residential Life staff, Teaching Assistants, and Transportation and Maintenance personnel.

Personality Variables

In this category, findings closely mirror both Rogers' (2003) theory constructs and psychosocial factors measured by the PIADS. Rogers has also noted differences in personality variables among adopter groups. Earlier adopters demonstrate greater empathy than later adopters. Earlier adopters may have more flexible, less rigid systems

of personal beliefs—in short, they are more open minded. People in Innovator, Early Adopter, and Early Majority groups tend to have a higher level of self-efficacy, score better on standard measures of intelligence, and exhibit more rational and abstract thinking capabilities. Also, people in early adopting groups usually have a positive outlook towards change in general and technology and science specifically than the individuals in late adopter categories. In this study, adopter category was highly correlated with personality variables, including Competence, Adaptability, and Self-esteem. According to PIADS developers (Day & Jutai, 1996), competence, adaptability, and self-esteem are closely tied to independence, self-efficacy, sensitivity to others, flexibility, and willing ness to try new things.

Communication Behaviors

Rogers (2003) noted that communication behaviors differ between early and late adopting groups. Earlier adopters are more socially participatory than later adopters, and are perhaps better communicators. Generally, people in early adoption categories have more exposure to communication medias and technologies than people in late categories. Level of adopter category was related to Hearing Level, Communication Mode, and Past Phone Use, all of which are potential indicators of communication behaviors, particularly for Deaf and Hard of Hearing people

who often communicate differently than the hearing public. Surprisingly, although significantly correlated to level of adoption, Hearing Level, Communication Mode, and Education were not listed as statistically significant in Discriminant Function 1. However, they were statistically significant in the second function along with variables of Title, Past Phone Use, Years Employed, and Training. The significance may indicate these predictor variables, though weighted less in predicting adopter category, are able to predict level of adoption.

Perceived Attributes of the Innovation

Perceived attributes of an innovation can be among the predominant factors in determining if the innovation will be adopted (Cooper & Zmud, 1990; Moore & Benbasat, 1991; Prescott & Conger, 1995). The diffusion of innovation theory states that five key perceived attributes of an innovation— relative advantage, compatibility, complexity, trialability, and observability— are positively related to adoption of an innovation (Rogers 1995,2003). Although the attributes of the VRS were not specifically under investigation in the current research, some general suppositions can be made about the perceived attributes of VRS and some known generalizations about the Deaf/Hard of Hearing community.

Relative Advantage

Recall that the degree to which an innovation is perceived as better than the one it replaces is termed relative advantage, which is positively related to rate of adoption (Rogers, 2003). VRS was designed as an alternative to traditional used captioning systems. TTY/TDD systems are a one-way mode of communication, which have a number of technical, linguistic, and cultural limitations for people who are Deaf or Hard of Hearing (Colonomos & Bienvenu, 1992; Elliot, 1987; Grossman; 2001; Holt, Traxler & Allen, 1997; Nelson, 1996). VRS systems have few if any of the limitations of TTY/TDD systems, so it may be assumed that the relative advantage of VRS over TTY/TTD is high. Additionally, Deaf and Hard of Hearing people often have negative experiences with the Hearing world (Lane, 1992 Lane, Hoffmeister, & Bahan, 1996; Schein, 1989). VRS provides a new option in ameliorating communication barriers with and isolation by the larger society that result in negative social, educational, and employment outcomes for the Deaf and Hard of Hearing, again supporting the notion of high relative advantage assignment to the VRS system. Residential Life Staff, Teachers, Counselors, and Teachers Aids, all of whom mentioned past difficulties with using TTY/TDD systems to call Hearing parents or service providers, anecdotally reported that communication in their native language through the VRS interpreter allows them to

communicate at a rate and effectiveness level sufficient to warrant future calls, thus clearly demonstrating that at least some of the study participants perceived favorable relative advantage with VRS and supporting the notion that in this study, relative advantage may have positively impacted early adoption.

Compatibility

To summarize from the literature review, compatibility refers to how well matched an innovation is perceived to be relative to a person's practical needs, existing personal or professional values, and past experiences. The compatibility of an innovation is positively related to its rate of adoption (Rogers, 2003). As discussed in the Literature Review, Gotherstrom, Persson, and Jonsson (2004) conducted a study to evaluate VRS satisfaction and to compare VRS with Text-based phone relay service in the areas of cost, quality of service, and quality of life outcomes. Participants stated strong preferences for the VRS services, despite the slightly higher cost of the equipment. Similar preferences may exist in the current study and related to high percentage of Early Adopters. VRS appears to be a system compatible with the practical communication needs of people who are Deaf and Hard of Hearing, but also with the Deaf community's philosophy, with it's emphasis on visual communication and preservation of ASL as a unique community identifier. Through VRS, the

intricate hand motion details, facial expressions, and positioning of the head and the body typical of signed communication are conveyed. Furthermore, VRS technology does not attempt to make Deaf/Hard of Hearing people fit the Hearing world and so does not appear to be oppressive to the Deaf community. Much more so than text based systems, VRS appears compatible with the underlying philosophies of the Deaf/Hard of Hearing world.

Complexity

The perception of an innovation's ease or difficulty in use is labeled Complexity. The complexity of an innovation is negatively related to its rate of adoption (Rogers, 2003). Simply put, the more complex an innovation is perceived to be, the less likely it is to be adopted. VRS is a visual communication system developed by Sorenson and is a basic relay system that is in many ways similar to the TTY/TTD relay systems that are highly familiar to most Deaf and Hard of Hearing people. VRS is essentially a simple system, requiring a minimum of three basic components: a video monitor such as a television or computer screen, a video camera, and high-speed broadband DSL line. Like the TTY/TDD system, VRS uses a third party relay operator. However, in the VRS system the relay operator, who is a skilled sign language interpreter, and the caller using manual language see each other through cameras linked to monitors and can therefore communicate

manually. As with the Relay system, an operator communicates with the Hearing caller over the telephone line. The VRS system can also be operated with a videophone, allowing everyone on the call to use manual communication directly with each other. So, Deaf or Hard of Hearing people can call each other, and once connected have a private conversation with no intermediary. To operate the videophone, two different components are needed: the monitoring hardware and a cable service. So, the relay system concept used in VRS is similar to that used in TTY/TDD, and the basic components needed for VRS are widely available at retailers carrying consumer electronics. While no in-depth studies have yet been undertaken regarding perceived complexity of video relay services and people who are Deaf and Hard of Hearing, it seems that most potential users may not perceive VRS as overly complex.

Trialability

In review, the trialability, or degree to which a person can experience trial use, of an innovation has been positively related to its rate of adoption (Rogers, 1995, 2003). Closely linked to Rogers' idea of "how to" knowledge, discussed in the Literature Review, device trialability allows users to have a hands-on experience with the technology or innovation at issue. In this study, opportunities for trialability were present. The administration of the Texas School for the Deaf reported

that all employees had undergone VRS training one year prior to the study. It was determined that thirteen research participants were newly hired and had yet not received VRS training. Also, self-report of VRS training was found to be inconsistent with the level of training reported by TSD administration. Specifically, about 45% of the Early Adopters reported receiving training while the remainder had not received training. This may be in part due to the ease of operation of the VRS system, or perhaps for this group, factors other than training are more critical to adoption.

A closer look at the training issue reveals another interesting finding. The Training variable showed significant correlations to Competence and Adaptability, and was the only demographic variable highly correlated with psychosocial variables. This makes sense considering that the aim of most training is to increase competence, and increased competence can lead to early adoption. Accordingly, it might be expected that there would be more laggards without training than with training, and indeed the results show approximately 28% of the laggards had training while 72% did not have training. Based on the literature, it was anticipated that more Early Adopters would have had VRS system training than not.

In addition to formalized training opportunities, the availability of the VRS technology located on the campus

may have been a factor in the larger than expected number of people in the Early Adopter category. The Texas School for the Deaf has made a strong commitment to the VRS system, with approximately 25 Sorenson VRS units spread across the campus. While some VRS systems are located in private offices, about 10 units are publicly available at any time. The ease of access to the VRS technology may have positively impacted trialability and in turn, adoption of the system, suggesting that adoption of the VRS in other settings could be facilitated by ensuring ease of public access to the device.

Observability

Observability refers to how visible the results of an innovation are to others, and observability is positively related to adoption of an innovation (Rogers, 2003). First available only two years ago, it might be assumed that opportunities for observable results are few, and from a broad or national standpoint, the assumption may be fairly correct. However, among research participants at TSD, observability appeared high anecdotally. Since the current research was not a qualitative study, nor was it a study of VRS usage trends, narrative data and data related to the results of VRS use at TSD were not collected. However, many participants spoke informally to this researcher about the perceived observability of VRS. Most notably, many participants shared stories about how they and their

colleagues viewed the results of VRS. For example, members of the Residential Life Staff reported increases in both the quantity and quality of their communication with Hearing parents of Deaf students. Administrators commented on their increased ability to participate in external meetings due to VRS use. So anecdotally, is does appear that observability of VRS was relatively high at TSD and may have had a positive impact on early adoption.

Implications for Practice and Policy

This study explored variables that are related to adoption of Video Relay Services among Deaf and Hard of Hearing employees at the Texas School for the Deaf. A number of possible implications of the study exist for both rehabilitation and rehabilitation-related practice and policy warrant discussion. Practical implications exist at the counselor/individual service provider level and at the state agency/service organization level, and policy implications exist for agencies/organizations and at national legislative levels.

Practical Implications

In an age of budgetary reductions it is important to be good stewards of tax dollars. The need for assistive technology (AT) for people with disabilities has been increasing as more useful products become available in recent years, though abandonment rates have been high resulting in wasted money and manpower. Once fully

validated, an instrument that predicts adoption of VRS and/or other communication technologies could prove very useful to the individual rehabilitation counselor; knowing the psychosocial and demographic variables that impact adoption of VRS may be beneficial in selecting appropriate candidates for receipt of VRS systems, thereby reducing ineffective budgetary expenditures. Also, the State/Federal agency and other similar organizations may be able to use the PIADS to help determine if VRS is a reasonable accommodation for their employees who might need such an accommodation or for consumers seeking their own workplace accommodations.

The findings of the current research also have implications for institutional implementation of assistive technology like VRS with employees and consumers who are Deaf or Hard of Hearing. Based on replicated findings, institutions like the Texas School for the Deaf (TSD), the Texas Commission for the Deaf and Hard of Hearing (TCDHH), and the Department of Assistive and Rehabilitative Services (DARS) may consider implementing and continuing formal VRS training for all employees. After further study replication and formal validation of the Psychosocial Impact of Assistive Device Scale (PIADS) for use with Deaf people, such agencies could better predict approximately how many employees and consumers would likely adopt the VRS system,

enabling them to better forecast budgetary requirements for equipment and related expenses.

Part of the conditions of conducting research at TSD included provision of the research results to TSD Administration. Upon the completion of the study, TSD will have empirical evidence of the importance of training in employee adoption of VRS and awareness of an instrument that would help determine whether their employees are likely to use the VRS system on the job. They may also be better able to forecast demands of the VRS system, allowing for more accurate budget allocations in the area of AT.

Policy Implications

At a local or organizational level, policy implications resulting form this study seem to center around issues of training policy, reasonable accommodation policy, and device access. The study findings have suggested that training and trialability have significant positive relationships to VRS adoption. Following additional study replication and confirmation of the results herein, agencies and/or service providing organizations may need to develop policy to institutionalize training and trialability opportunities. Also, institutions and organizations may need to develop policy related to the provision of VRS as a reasonable accommodation, especially when a TTY/TTD is already in place and VRS is requested preferentially. Related policy

may also be need around public access to VRS instead of TTY/TDD. Implementation of VRS services in public locations may assist with obtaining better employment for people who are Deaf or Hard of Hearing, and public policy to ensure access may be needed. Because of the potential positive impact of VRS, it may be suggested that VRS be implemented in all locations that currently require TDD/TTY access.

As occurred with TTY/TDD systems in the 1980's and 1990's, VRS systems will be increasingly evaluated under the Americans with Disabilities Act (1990) and the Technology Act (2004), as well as by Federal Communications Commission (FCC) standards. Currently, the FCC considers VRS to be equivalent to a telephone call, but says that VRS can only be used for between parties in separate locations, not in the workplace with co-workers. While FCC policies help maintain high technical standards, stringent network security, and ensure continual access to expert sign language interpreters, the current stance at the FCC will need to change n order to more fully fund VRS as a workplace accommodation (Robitaille, 2004).

Recommendations for Future Research

Results of the current study suggest the need for further research in the areas of adoption and discontinuance of VRS and other communication technologies for people who are deaf and Hard of Hearing. Initially, additional research should be conducted with the entire

population of TSD. Also, additional research is needed to replicate and expand the findings in other state schools for the deaf. More qualitative studies would also be beneficial in capturing the nuances of the decision making process for people who are Deaf/Hard of Hearing, along with their specific kudos and concerns related to a visually-based relay system.

More formal validation of the PIADS with Deaf and Hard of Hearing individuals seems appropriate for study, as does exploration of translation of the PIADS into ASL. Additionally, it is recommended that similar studies be conducted on other types of Assistive Technology to determine whether the PIADS is able to discriminate among levels of adoption of other forms of AT with Deaf and Hard of Hearing people. In addition to communication devices for the Deaf and Hard of Hearing, the psychosocial impact of other communication devices might prove to be beneficial to the fields of Special Education and Vocational Rehabilitation. Specifically, one might study the impact that distance education, whether on-line classes or video conferencing, has on the psychosocial impact of the individuals or groups using AT. As in this study, further investigation in these areas might be beneficial to determining best practices from a training and management stand point.

Conclusion

This study examined the psychosocial and demographic variables that were shown to discriminate among adopter categories with respect to Video Relay Services with the Deaf and Hard of Hearing Employees of the Texas School for the Deaf. Using Multiple Discriminant Analysis (MDA), the psychosocial variables measured by the Psychosocial Impact of Assistive Devices Scale (PIADS), (a) Competence, (b) Adaptability, and (c) Self-Esteem were found to account for 72.8% of the total variance of the predictor or discriminating variables in the study. To a lesser extent, several demographic variables were demonstrated as statistically significant discriminators regarding adopter category, specifically Communication Mode, Job Title, Past Phone Use, Years Employed, Hearing Level, and Training. The function related to these particular variables accounted for 21.4% of the variance. Consistent with the literature, Function 3, made up of Age, Gender, and Education Level, did not have enough variance, 5.8%, to be considered statistically significant.

The frequencies of Early Adopters and Early Majority were reversed from expected results of Rogers' (2003) theory and normal distribution patterns. These two groups still represented 49.5% of the total population, which is collectively consistent with a normal distribution. The second half of the distribution, Late Majority and

Laggards, follow Rogers' (2003) theory and reported normal distribution patterns; they represented 50.5% of the total population. With this information, one can argue that of the Deaf and Hard of Hearing population, those who are considering adopting an innovation (Early Majority) tend to do so faster than expected from other populations. This phenomenon results in greater deviation between the Late Majority and Early adopters than predicted by Rogers' theory (2003).

Notably, Educational Level not being significantly involved in discriminating among adopter categories is inconsistent with the literature. Rogers (2003) stated that Early Adopters tended to have higher levels of education, pay and expendable income than the individuals in the Late Adopter and Laggard categories. In this study, the Early Adopter group had only 30% more of its members reporting greater than or equal to a Bachelors degree of education. With the Deaf or Hard of Hearing sample investigated, the normal distribution of adopter categories as described in Rogers' (2003) theory did not accurately predict the distribution of individuals across adoption categories in this study.

Another interesting result is the correlation of Training with the psychosocial variables. In this study, Training was highly correlated with Competence and Adaptability. Considering Competence and Adaptability were

two of the first discriminant function to discriminate group membership in Adopter Categories, one can argue that the implementation of training might have had a positive effect on the decision process to adopt VRS.

These finding illustrate the importance psychosocial factors in the decision to adopt communication assistive technology within the Deaf and Hard of Hearing population. This information is relevant to the field of Vocational Rehabilitation on many levels. Based on the findings of this study the Vocational Rehabilitation Counselor has access to an instrument that can reliably provide quantified psychosocial data to predict adopter category with consumers who are Deaf or Hard of Hearing. Vocational Rehabilitation Counselors will be better stewards of public funds, by possibly reducing the abandonment rate of AT provided to their consumers.

From an administrative standpoint, it is not only important for the direct service providers to be able to quantify psychosocial variables with regards to identifying a client's adopter category, but also beneficial to the agency managers dealing with employees. Being able to discriminate the members of the agencies into adopter categories may help foster a smooth transition from a current system to future systems, in terms of time and budgetary requirements.

Video Relay Services Background Questionnaire

Thank you for taking time to complete this background questionnaire and the Psychosocial Impact of Assistive Devices Questionnaire (PIADS). This information will help with research related to the psychosocial impact and adoption of Video Relay Services (VRS). When finished with the survey, please hand it back to me or if you prefer, deliver them to Dr. David Coco's office. **All responses will be kept confidential until the study is completed and then they will be destroyed**. If you have any questions, concerns or need assistance completing the form, please do not hesitate to let me know. You can contact me, Shawn P. Saladin, at saladin@mail.utexas.edu.

1. Please provide your demographic information in the space provided.
2. Today's date: _____.
3. Number of years employed with TSD: _____
4. Job title: _____, Number of years in this position: ____
5. Have you received VRS training? ____Yes _____No. If yes, approximately when? ____
6. Who provided your training?

   _____
7. Gender: Male/Female (circle one)
8. Highest level of formal education achieved (circle one): (1) did not graduate from high school, (2) high school graduate, (3) some college, (4) college graduate – Bachelors Degree, (5) some graduate school, (6) Graduate Degree – Masters or Doctorate Degree
9. How did you learn of Video Relay Services? (Circle one) (1) Did not know it exists, (2) TSD training, (3) Family, (4) Friends, (5) other_____
10. Do you consider yourself: (1) Deaf, (2) Hard of Hearing or (3) Hearing (circle one)

11. What is your primary mode of communication? (Circle one or write in) (1) Signing, (2) Speech reading, (3) Hearing, (4) Total communication, (5) other _____
12. In the past when you have needed to make a phone call, did you usually (circle one): (1) use a regular phone line, (2) use a TTY/TDD, (3) have another person make the call, (4) use email or (5) other methods?
13. If you use VRS at work, what is the main reason? (For example, to talk to a consultant about a student)

14. If you use VRS at home, what is the main reason? (For example, to schedule medical appointments, or keep in contact with family and friends)

Appendix 2: Psychosocial Impacts of Assistive Devices Scales

Table 3: PIADS Questionnaire Version 3.0

Psychosocial Impact of Assistive Devices Scale (PIADS) Today's Date: _____ month/day/year

Client Name:_____ (last name, then first name) ☐ male ☐ female

Diagnosis:_____ Date of Birth:_____ month/day/year

The form is being filled out at (choose one) **1.** ☐ home **2.** ☐ a clinic **3.** ☐ other (describe):_____

The form is being filled out by (choose one) **1.** ☐ the client, without any help **2.** ☐ the client, with help from the caregiver (e.g., client showed or told caregiver what answers to give) **3.** ☐ the caregiver on behalf of the client, without any direction from the client **4.** ☐ other (describe): _____

Each word or phrase below describes how using an assistive device may affect a user. Some might seem unusual but it is important that you answer every one of the 26 items. So, for each word or phrase, put an "X" in the appropriate box to show how you are affected by using the _____ (device name).

	Decreases	-3	-2	-1	0	1	2	3	Increases
1)	competence	☐	☐	☐	☐	☐	☐	☐	
2)	happiness	☐	☐	☐	☐	☐	☐	☐	
3)	independence	☐	☐	☐	☐	☐	☐	☐	
4)	adequacy	☐	☐	☐	☐	☐	☐	☐	
5)	confusion	☐	☐	☐	☐	☐	☐	☐	
6)	efficiency	☐	☐	☐	☐	☐	☐	☐	
7)	self-esteem	☐	☐	☐	☐	☐	☐	☐	
8)	productivity	☐	☐	☐	☐	☐	☐	☐	
9)	security	☐	☐	☐	☐	☐	☐	☐	
10)	frustration	☐	☐	☐	☐	☐	☐	☐	
11)	usefulness	☐	☐	☐	☐	☐	☐	☐	
12)	self-confidence	☐	☐	☐	☐	☐	☐	☐	
13)	expertise	☐	☐	☐	☐	☐	☐	☐	
14)	skillfulness	☐	☐	☐	☐	☐	☐	☐	
15)	well-being	☐	☐	☐	☐	☐	☐	☐	
16)	capability	☐	☐	☐	☐	☐	☐	☐	
17)	quality of life	☐	☐	☐	☐	☐	☐	☐	
18)	performance	☐	☐	☐	☐	☐	☐	☐	
19)	sense of power	☐	☐	☐	☐	☐	☐	☐	
20)	sense of control	☐	☐	☐	☐	☐	☐	☐	
21)	embarrassment	☐	☐	☐	☐	☐	☐	☐	
22)	willingness to take chances	☐	☐	☐	☐	☐	☐	☐	
23)	ability to participate	☐	☐	☐	☐	☐	☐	☐	
24)	eagerness to try new things	☐	☐	☐	☐	☐	☐	☐	
25)	ability to adapt to the activities of daily living	☐	☐	☐	☐	☐	☐	☐	
26)	ability to take advantage of opportunities	☐	☐	☐	☐	☐	☐	☐	

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Appendix 3: Glossary of PIADS items

Glossary of PIADS Items

Ability to Adapt to the Activities of Daily Living (item 25) Ability to cope with change; ability to make basic tasks more manageable

Ability to Participate (item 23) Ability to join in activities with other people

Ability to take advantage of opportunities (item 26) Ability to act quickly and confidently when there is a chance to improve something in your life

Adequacy (item 4) Capable of handling life situations, and handling little crises

Capability (item 16) Feeling more capable; able to cope

Competence (item 1) Ability to do well the important things you need to do in life

Confusion (item 5) Unable to think clearly, act decisively

Eagerness to Try New Things (item 24) Feeling adventuresome and open to new experiences

Efficiency (item 6) Effective management of day to day tasks

Embarrassment (item 21) Feeling awkward or ashamed

Expertise (item 13) Knowledge in a particular area or occupation

Frustration (item 10) Being upset about lack of progress in achieving your desires; feeling disappointed

Happiness (item 2) Gladness, pleasure; satisfaction with life

Independence (item 3) Not dependent on, or not always needing help from, someone or something

Performance (item 18) Able to demonstrate your skills

Productivity (item 8) Able to get more things done in a day

Quality of Life (item 17) How good your life is

Security (item 9) Feeling safe rather than feeling vulnerable or insecure

Self-Confidence (item 12) Self-reliance; trust in yourself and your abilities

Self-Esteem (item 7) How you feel about yourself, and like yourself as a person

Sense of Control (item 20) Sense of being able to do what you want in your environment

Sense of Power (item 19) Sense of inner strength; feeling that you have significant influence over your life

Skillfulness (item 14) Able to show your expertise; perform tasks well

Usefulness (item 11) Helpful to yourself and others; can get things done

Well-being (item 15) Feeling well; optimistic about your life and future

Willingness to Take Chances (item 22) Willing to take some risks; willing to take on new challenges

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